

ILLUSTRATED MANUAL
OF
OPERATIVE SURGERY
AND
SURGICAL ANATOMY,

BY
MM. CL. BERNARD, D.M.P., AND CH. HUETTE,

EDITED, WITH NOTES AND ADDITIONS,
AND ADAPTED TO THE USE OF THE AMERICAN MEDICAL STUDENT

BY
W. H. VAN BUREN, M.D.,
SURGEON TO BELLEVUE HOSPITAL, ETC.,

AND
C. E. ISAACS, M.D.,
DEMONSTRATOR OF ANATOMY, COLL. PHYS. AND SURG., NEW-YORK.

ILLUSTRATED WITH STEEL ENGRAVINGS, FROM DRAWINGS AFTER
NATURE,

BY M. J. LÉVEILLE,

DESIGNED TO SERVE AS A COMPANION TO THE ORDINARY TEXT BOOKS
OF SURGERY.

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OPERATIVE SURGERY.

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PREFACE TO THE AMERICAN EDITION.

IN presenting to the American Student of Surgery the beautifully illustrated work of MM. Bernard and Huette, the editors flatter themselves that they have contributed to the supply of a want which has not been unfrequently experienced heretofore, viz.: a complete and concise picture of the science and art of Operative Surgery, in its present advanced and perfected condition, in a portable form. The admirable and extensive works of Bourguery and Jacob, and Prof. Velpeau, with the translation of the latter under the auspices of Prof. Mott, and the equally excellent treatise on Operative Surgery by Prof. Pancoast of Philadelphia, can never be replaced by the present work. Yet its compactness and portability will render it more desirable to the student as a companion in the lecture and dissecting room, where its copious and graphic illustrations will assist him materially in acquiring correct general ideas as to the nature and objects of the individual operations of surgery; whilst for more minute and varied details with regard to their history and numerous modifications, the less accessible and more expensive treatises alluded to can be consulted at a more advanced period of study. In fact they are better calculated for works of reference to the practitioner of surgery, than as text books for the student, designed to set forth concisely the elements of the art. Our manual, whilst it is intended mainly to illustrate the interi-

cacies of operative surgery by appealing to the eye as well as to the understanding of the student, and by familiarizing him with that most useful department of anatomy which immediately relates to surgical operations, will also be found, it is hoped, not entirely useless as a work of reference to those already engaged in practice.

It has been the object of the translators to Americanize the language of the work to as great an extent as possible, making use of the terms in ordinary use in this country by teachers of anatomy and surgery, in order that the American student may not be annoyed by meeting with foreign modes of expression with which he is not familiar, and which, in their opinion, it is rarely desirable to introduce into common use. This almost invariable peculiarity of French translations has heretofore interfered both with their popularity and general utility; it has therefore been their endeavor to avoid it.

The additions, in the form of notes, which it has been thought proper to append to the original text, will not, it is hoped, be found to detract from its value.

New-York, October, 1851.

PL. I.

Fig. 3.



Fig. 1.



Fig. 2.



Fig. 4.



Fig. 5.



Fig. 6.

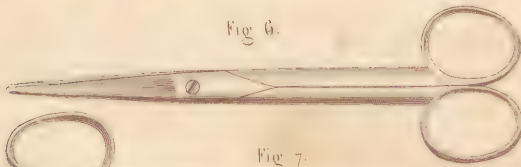


Fig. 7.

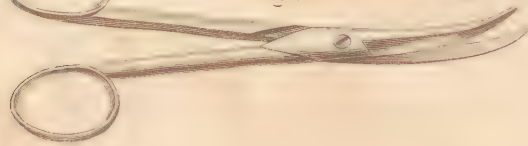


PLATE I.

INSTRUMENTS REQUIRED FOR MAKING INCISIONS.

Fig. 1. Straight bistoury.

Fig. 2. Convex bistoury.

Fig. 3. Probe-pointed bistoury.

aaa back of the bistoury.

bbb edge of the bistoury.

ccc joint of the handle and blade.

ddd end of the handle.

Fig. 4. Ordinary dissecting forceps.

aa jaws of the forceps.

Fig. 5. Director.

a groove of the director.

b probe-like end of the director.

b' extremity of a director in which the groove is continuous to the end.

Fig. 6. Straight scissors.

Fig. 7. Scissors curved on their cutting edges.

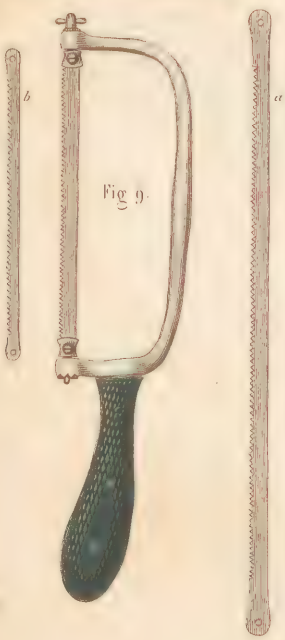
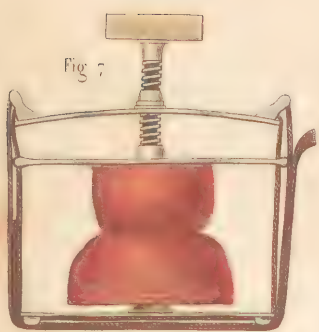
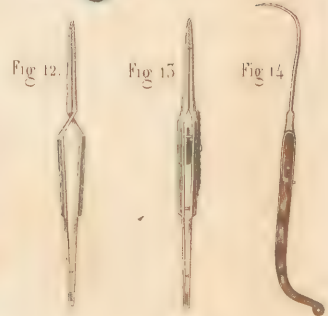
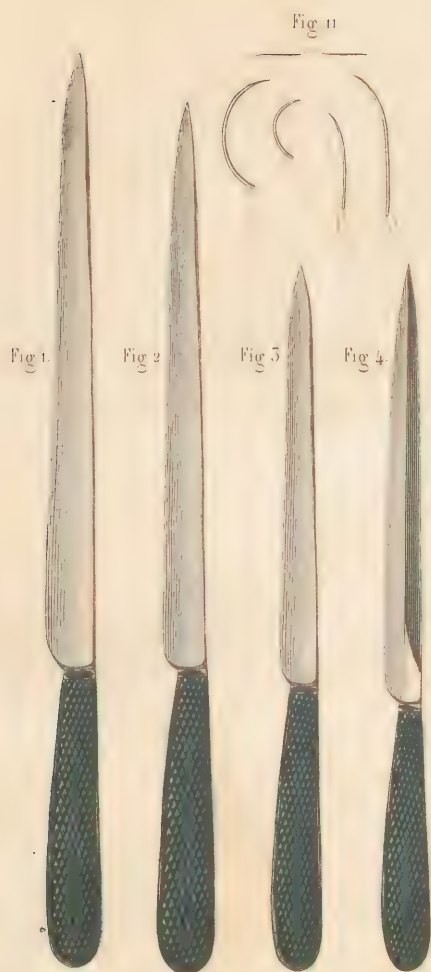
PLATE II.

INSTRUMENTS REQUIRED FOR LIGATURE OF ARTERIES.

- Fig. 1. Charrière's forceps for continued pressure.
- Fig. 2. Graefe's spring artery forceps.
- Fig. 3. Charrière's curved forceps for continued pressure.
- Fig. 4. Amussat's torsion forceps.
- Fig. 5. Tenaculum.
- Fig. 6. Deschamps' artery needle.
- Fig. 7. Director, with an eye in its extremity.
- Fig. 8. Cooper's artery needle.
- Fig. 9. Eyed probe.
- Fig. 10. Sottot's knot-tightener.

PL. II.





PLATES III. & IV.

INSTRUMENTS REQUIRED FOR AMPUTATIONS.

- Figs. 1, 2, 3. Amputating knives of different sizes.
Fig. 4. Interosseous knife, or catlin.
Figs. 5 and 6. Bone forceps.
Fig. 7. Charrière's tourniquet.
Fig. 8. Ordinary amputating saw.
 a extra blade.
Fig. 9. Small amputating saw.
 b extra blade.
Fig. 10. Chain saw.
 c needle to conduct it.
 d handle to be attached after the introduction of the saw.
Fig. 11. Suture needles.
Fig. 12. Charrière's forceps for continued pressure.
Fig. 13. Amussat's torsion forceps.
Fig. 14. Tenaculum.

PLATES V. & VI.

INSTRUMENTS FOR EXSECTION OF BONES.

Fig. 1. Hey's saw.

Fig. 2. Knife-shaped saw.

Fig. 3. Small semicircular saw.—*a*, surface for a point of support to the index finger of the hand, holding the instrument, when it is desired to employ force with precision of motion.

Fig. 4. Larrey's straight saw.

Fig. 5. Martin's saw.—This consists of a rod, *a b*, with a circular saw at its extremity, *c*. A rotary motion is given to the rod, *a b*, and to the saw at its extremity, by another rod, *d e*, which is connected with the first by a universal joint, *f*. This arrangement allows the saw to move freely at any angle which the two rods may form with each other. The extremity, *h*, of the rod, *d e*, fits into the shaft of a trepan (fig. 5, *bis*) which is moved by an assistant, whilst the operator, holding the handle, *i*, which is traversed by the rod, *a b*, directs the action of the saw and graduates its force, using more or less pressure, as may be required. Saws of different diameters, *j*, or shaped like a mushroom, *k*, may be fitted to the rod, *a b*, according to circumstances.

Fig. 6. Charrière's rowel saw.—A crank, *a*, moves the wheel, *b*, the teeth of which, interlocking with those of the wheels, *c d e*, transmit a rotary motion to the saw, *f*. By means of this instrument, which is solid, firm, and of easy application, we can operate on bones which are very deeply seated. Saws of different diameters can be adapted to it.

Fig. 7. Dupuytren's perforator.—An instrument used for breaking up deeply seated *sequestra*, when they cannot be withdrawn whole on account of the narrowness of the external opening. Two serrated jaws, *aa*, which can be opened and closed at will, grasp the bony fragment, which is then acted upon by a central drill, put in motion by a bow, the string of which encircles the grooved wheel, *c*.

Fig. 8. Liston's bone forceps, used for dividing small bones at a single cut.

Fig. 9. Strong forceps, for holding steadily a portion of bone whilst being sawn.

Fig. 10. Forceps for the extraction of *sequestra*.

Figs. 11 and 12. Chisel and gouge.

Fig. 13. Leaden mallet.

Fig. 14. Rasp.

Fig. 15. Olive-shaped cautery-iron, in its handle.

Fig. 16. Hatchet-shaped cautery-iron.

Fig. 17. Nummular cautery.

PL. V.



PL. VI.



SURGICAL OPERATIONS.

INSTRUMENTS EMPLOYED
IN
SURGICAL OPERATIONS.

Pl. 1

Fig. 1



Fig. 3.



Fig. 4



Fig. 5.



Fig. 6.



Fig. 2.



PLATE I.

METHODS OF HOLDING THE BISTOURY.

THE positions in which the bistoury may be held are liable to infinite variety; nevertheless, for the purposes of operative surgery, these positions may be reduced to three, and each of them subdivided into two varieties.

First Position (fig. 1 and 2). The handle of the bistoury is held firmly in the whole hand, like a table knife. In this position, the end of the handle of the instrument always rests in the palm of the hand, whilst the cutting edge may be turned either downwards (as in fig. 1), when the index finger is extended upon the back of the blade; or upwards (as in fig. 2), when the index is placed near the junction of the blade with the handle, and on its side. The first position is the best, whenever great firmness or force is required in the use of the instrument.

Second Position (fig. 3 and 4). The bistoury is held like a pen in writing, the cutting edge being turned either downwards (fig. 3), or upwards (fig. 4). This position of the instrument is suitable when we desire its movements to be at the same time delicate and precise.

Third Position (fig. 5 and 6). The bistoury is held like the bow of a violin. In one of the varieties of this position, the point of the instrument is carried forward with its edge downwards (fig. 6); in the other the point is carried backwards, with the edge upwards (fig. 5). This position is employed when we wish to use the knife with the utmost delicacy and prudence.*

* In this country, as in England, the ordinary scalpel is most generally employed by surgeons in operations upon the living body, in preference to the French bistoury, as well as in dissections of the dead. And there is a manifest advantage in the employment of a similarly shaped instrument for both purposes, as that instrument which the operator is most in the habit of using will always serve his purpose best under circumstances of difficulty. The shape of the scalpel undergoes slight variations, according to the fancy of individuals, and the above rules with regard to position are entirely applicable to it.—Eds.

INCISIONS.

In cutting the integuments with the bistoury, or scissors, the object ordinarily in view is to open a passage towards deeper seated tissues, either for their simple exposure, or their removal. Under different circumstances, then, the incision may be made either *from without inwards*, or *from within outwards*.

In cutting from *without inwards*, the skin should always be previously put upon the stretch, in order to avoid its wrinkling, and to facilitate its division under the edge of the bistoury, which should always cut by being drawn across the tissues with a suitable amount of pressure, applied so as to leave the cut surfaces perfectly perpendicular.

1st. *Simple Incisions*. The skin being firmly drawn and stretched over the deeper parts by the left hand of the surgeon, or by his assistants, the operator takes a straight bistoury in the first or second position (fig. 1 or 3), plunges it at first perpendicularly to a sufficient depth, and afterwards inclines it to an angle of about 45° , until the incision has reached the desired length, when he brings it out again perpendicularly, in order to avoid making an oblique section of the skin at the end of the cut. The same rules are followed in making all simple incisions, whether straight or curved.

Sometimes it is necessary to avoid with especial care the parts immediately beneath the skin. In such a case the incision should be made with a convex bistoury, held in the third position (fig. 6), dividing the tissues carefully, layer by layer. Or, by pinching up a fold of skin, one end of which is held by an assistant, the bistoury being held in the first position, the fold may be divided by cutting it downwards perpendicularly, or by transfixing its base and cutting outwards in the same direction, a simple straight incision being the result in either case (fig. 2).

2d. *Compound Incisions*. These are formed by the meeting, or intersection, of two or more simple incisions. The principal varieties are : 1st, the incision resembling the letter V, where two simple incisions meet at an acute angle; if they meet at a right angle, it is said to resemble the letter L. 2d, the T incision, where one incision falls perpendicularly upon the centre of another; when they intersect each other at a right angle, a crucial incision is the result; when several incisions converge towards a common centre, they form a star. When several incisions are to be made intersecting each other, it can be done

to the best advantage, especially where the skin is loose and yielding, by making a long straight cut in the first place, and then, whilst firmly stretching its borders by a hand at either end, making the others rapidly across it.

3d. *Incisions from within outwards.* These are effected either with, or without, the assistance of a director. By one method, the bistoury, held in the second or third position, is inserted obliquely beneath the skin, or aponeurosis, or into the sinus which is to be laid open, and then brought up into a perpendicular position, by which movement the parts covering its edge are freely divided, the knife cutting from its heel towards its point. In a second method the instrument, in its first position, is introduced under the skin, with or without a director, to the point where the incision is to be terminated; then thrusting its point through the integuments, from within outwards, the incision is completed by lowering the wrist and cutting out, from the point towards the heel of the knife.

PLATE II.

UNION OF WOUNDS.

THE different methods of promoting the union of wounds vary according to the nature and condition of the solution of continuity, and the ultimate object which the surgeon has in view. When a wound has commenced to suppurate, we simply, by means of different modes of dressing, endeavor to prevent the gaping of its edges, and the unnecessary retention of the purulent discharge, whilst watching the process of cicatrization. But when immediate union of the wound is sought after, union by the first intention, as it is called, it is necessary that its edges should be retained very accurately in contact, in order that the adhesive inflammation about to develop itself shall effect their permanent agglutination. When wounds are not very irregular in their form, or when they are situated on the extremities, or on a convenient part of the body, it is sometimes possible to keep their edges in accurate apposition by means of position, and the judicious use of adhesive plasters and bandages; but in a great many instances it becomes absolutely necessary to resort to a regular operative procedure, viz.: the application of sutures.

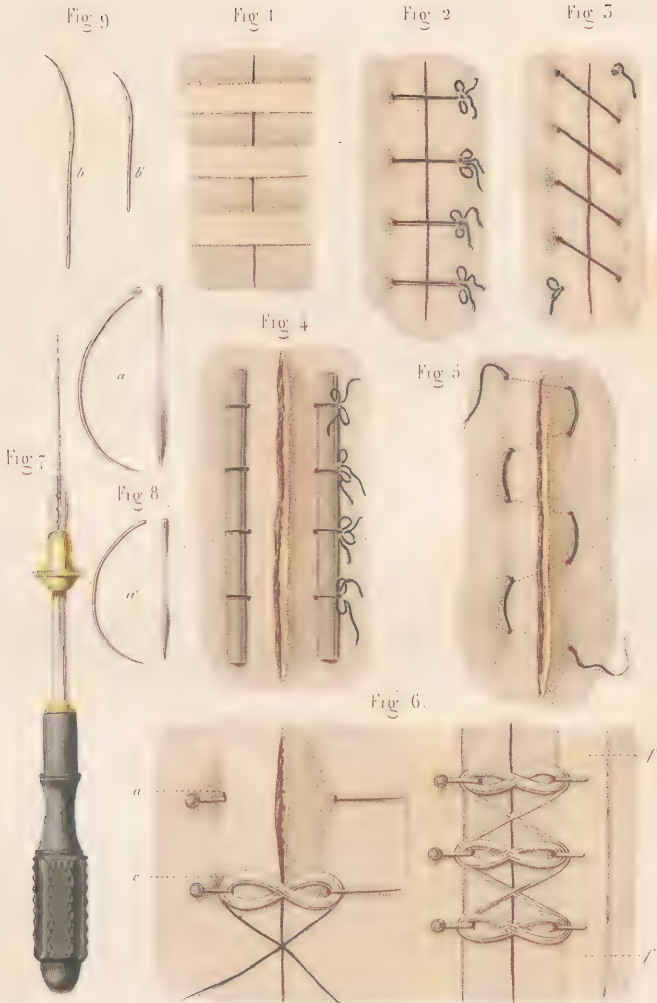
FIG. 2, 3, 4, 5, 6. SUTURES.

The object of the application of sutures is to retain in accurate contact the lips of a wound, when, from its form or position, plasters or bandages will not answer the purpose.

The instruments required for the introduction of sutures are needles and ligatures. The flattened needle of Boyer, curved in the form of an arc of a circle, *a a*, and that of Velpeau, with its eye on the side, curved, but flattened only on its anterior half, *b b*, are in most general use; for particular operations, needles of other shapes are employed—these will be described in their proper connection.* The needle-carrier (fig. 7) is

* The straight round needle with a triangular point, of different sizes, is much used in this city. It answers fully as well in the great majority of wounds as the old-fashioned curved needles, and is unquestionably managed with more facility.—Fns.

Pl. 2.



only used when the nature of the tissues requires the employment of much force in the introduction of the needle.

In regard to their mode of application, and the manner in which their purpose is effected, sutures are divided into three species. 1st, *The simple, or Pelletier's suture* (fig. 2 and 3), which approximates the lips of the wound, edge to edge; 2d, *The zig-zag, or basting suture* (fig. 5), by which the deeper portions of the cut surfaces are brought in contact; 3d, *The twisted suture* (fig. 6), which effects both of these objects, keeping the deeper portions of the wound together, whilst its cutaneous edges are also maintained in accurate apposition.

1st. *Simple suture* (fig. 3) is effected by passing a needle with its ligature through both of the lips of the wound which are to be kept in contact. To do this the operator passes the needle from without inwards through the right border of the wound at a distance of two to three lines from its edge; its point is then pushed forward in such a manner as to perforate from below upwards the left border of the wound at the same distance from its edge; the convexity of the needle always presenting towards the bottom of the wound. Sometimes the irregular shape of the wound, or the separation of its lips from each other, renders it impossible for both of them to be perforated at the same time by the same needle; in this case a ligature armed with two needles may be employed, each of which is passed through a lip of the wound, from within outwards.

The first point of suture being thus effected, the rest are applied in like manner, until the edges of the solution of continuity are in contact throughout. When several sutures are thus introduced without cutting the thread, the *continued*, or *glover's suture* is the result (fig. 3). On the contrary, when the thread is cut and tied over the wound between each point of suture, it is then known as the *interrupted suture* (fig. 2). Finally when, in place of tying together the ends of each of the threads, they are all brought together in a single bundle, and fastened at a distance, so as to keep up their tension, we have Ledrans', or the *looped suture*, sometimes applied to wounds of the intestines (v. *Enteroraphy*).

2d. *Zig-zag, or basting suture* (fig. 3). This is commenced exactly in the same manner as the simple suture, that is to say, a single needle is inserted through both lips of the wound, but its thread, instead of passing back again across the wound, is carried along, and parallel with, its border, until the next point is reached, from which it is passed again through both of its lips to the side from which it was at first introduced.

The needle being thus inserted alternately from either side of the wound, without the thread being cut, a species of zig-zag is described by it from which the suture takes its name (fig. 5). *The quilled suture* (fig. 4) is evidently a variety of this latter; it tends also to bring together the deeper portions of a wound, only the loops of the ligature which produce this result in the zig-zag suture are here replaced by a piece of a gum elastic catheter, or the barrel of a quill. The manner in which it is done is by passing, in the first place, through the lips of the wound, as many double ligatures as it is wished to make points of suture; the quill or bougie is then introduced, parallel to the edge of the wound, through the loops formed by the doubling of the ligatures, whilst their free ends are tied, with the necessary degree of tightness, over another quill at the opposite side of the wound.

3d. *Twisted suture.* This species of suture combines the results of both of those previously described, only it is done in a different manner; instead of an ordinary ligature, a metallic pin or needle is passed through the lips of the wound—either an ordinary pin, *a*, or the insect pins, which Dieffenbach prefers. By the first step the deeper portions of the cut surfaces are brought in contact, and to produce the same effect upon the cutaneous edges of the wound, a ligature is applied around each pin in the form of the figure 8, its ends being crossed in passing to the next pin, where the process is repeated. The operation is finished by cutting off the points of the pins, and placing a longitudinal strip of adhesive plaster between their extremities and the skin, to prevent the latter from being irritated by the cut ends, *ff*.

Pl. 3.

Fig 1.



Fig. 3.

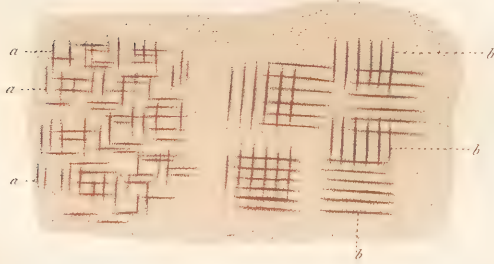


Fig 5

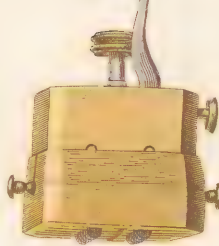


Fig 2



Fig 4



PLATE III.

OF THE SETON.

THE object of the seton is to establish and keep up a drain, or issue, by means of a strip of cotton, or linen tape, introduced beneath the skin. It is most frequently made use of in the nape of the neck, but may be applied with advantage in many other localities.

FIG. 1. SETON IN THE NAPE OF THE NECK.

Having pinched up the skin of the back of the neck in a vertical fold, one end of which is held by an assistant, the operator transfixes the base of the fold by a straight bistoury held in the first position, and enlarges the incisions thus made to the requisite extent; then by means of the eyed-probe, *ab*, the strip of linen, *c*, previously greased with cerate, is passed through the wound made by the bistoury, and the fold of skin is allowed to resume its natural position.

The dressing consists of a piece of linen in which a number of small holes have been cut, spread with cerate and placed upon the wound; over this is a small wad of lint for the purpose of absorbing the discharge which escapes through the holes in the linen, covered by a compress, in the folds of which the excess of the seton is coiled. A circular turn of a bandage around the neck retains the dressing in position, and it should not be renewed until the fourth or fifth day, by which time suppuration will have been established. At each dressing a new portion of the seton, well greased, is drawn into the wound, and the soiled end cut off; when the seton is exhausted a new one is sewed to its extremity.

Boyer's suture needle (fig. 1 *bis*), which carries the seton through at the same time that it makes the wound, may be substituted for the bistoury and eyed-probe. This instrument, however, is not much used.*

* The English seton needle, which differs slightly from Boyer's, is a convenient instrument, and very generally employed in this country; it can be introduced more rapidly and with less pain than the bistoury and eyed-probe.

The substitution of a strip of india-rubber cloth for linen or cotton, is also an im-

FIG. 2. VACCINATION.

Ordinarily the upper and outer part of the arm is selected for the insertion of the vaccine virus. There are four methods of doing this : 1st, *by friction* ; 2d, *by a blister* ; 3d, *by scarification* ; 4th, *by puncture*.⁵ We will describe the latter only, which is the mode most in use.

To vaccinate by puncture the ordinary lancet, or what is better, the vaccinating lancet, *a b*, is the instrument generally preferred. This is previously charged with the virus, either by inserting it into a mature vesicle, when we vaccinate directly from arm to arm, or by making use of preserved matter. The lancet is then introduced almost horizontally beneath the surface of the skin to the distance of about a line, the operator endeavoring to make the instrument pass as it were between the epidermis and the true skin ; it is allowed to remain for a few seconds and then withdrawn in such a manner as to wipe off the virus from the point of the instrument, the withdrawal of which is generally followed by a small drop of blood. In this manner three or four punctures are made in each arm, which must be allowed to dry perfectly before the infant is dressed.

FIG. 3. SCARIFICATIONS.

The term *bird-peck punctures*, *aaa*, is applied to a number of superficial punctures rapidly made with a lancet-shaped needle, or a well-pointed lancet, with the view of depleting inflamed or œdematous tissues.

Scarifications are small superficial incisions, made close to each other for the purpose of causing a flow of blood ; it is a very ancient method of effecting depletion of the capillaries. They may be made with a lancet, a razor, or even a bistoury, held in the third position. With a view of lessening the pain when made in this manner, the Germans have invented a scarificator (fig. 3 *bis*), in which, by means of a spring, some fifteen or twenty small blades are made to cut at one stroke ; thus the duration of the operation is much diminished.

FIG. 4. ACUPUNCTURE.

The operation of *Acupuncture* consists in the introduction of needles made for the purpose, *a, b, c*, into different parts of the body. When
provement, as it does not absorb the discharge from the wound ; nor does it require constant renewal and methodical dressing, but may be tied in a loop and allowed to remain, which, with children, is an advantage.—Eps.

the needles are placed in communication with the poles of a machine, with the object of passing a current of electricity through a limb or a diseased part, the operation takes the name of *electro-puncture*. Of late electro-puncture has been employed, and in several instances with success, to produce the coagulation of the blood in arteries, and in this manner to effect a cure of aneurism.

There are different modes of introducing the needles—either suddenly by a single thrust, or in a more gradual manner, by rolling the handle of the needle between the thumb and index finger, whilst pressing it gently onwards. Sometimes also it is driven forwards by a series of gentle taps upon its head. The pain is but trifling by either method.

PLATE IV.

1ST. BLEEDING FROM THE ARM.

FIG. 1. ANATOMY OF THE PART.

THE skin and adipose tissue which cover the veins at the bend of the arm have been removed by dissection, as well as the subjacent brachial aponeurosis, 2, in order to demonstrate the relation of the deeply seated parts with the superficial veins.

These are, reckoning from without towards the inner border of the arm :

A. *The radial vein*, accompanied by some small branches, *a*, of the musculo-cutaneous nerve.

B. *The median cephalic*, crossed by the internal branch, *b*, of the musculo-cutaneous nerve.

C. *The cephalic vein*, formed by the union of the two preceding ; the main trunk of the musculo-cutaneous nerve, *c*, lies along its inner border.

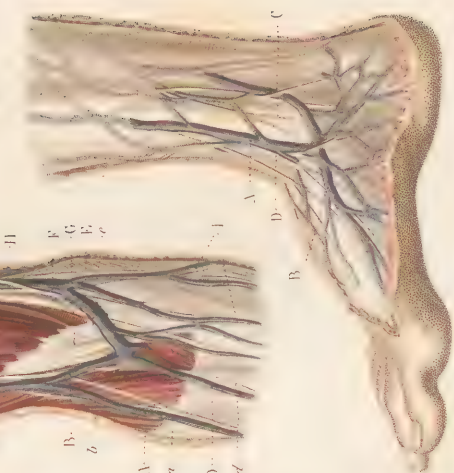
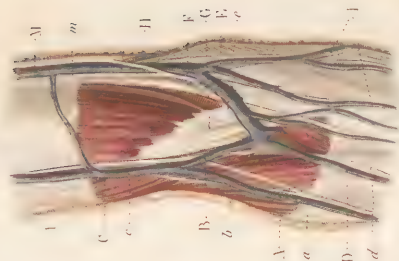
D. *The common median vein*, with branches from the musculo-cutaneous and internal cutaneous nerves.

E. The *median basilic*, accompanied by the anterior branch, *e*, of the internal cutaneous nerve. Larger and more superficial than the preceding, the median basilic vein runs parallel, in its external half, with the brachial artery, from which it is separated by the aponeurotic expansion given off by the tendon of the biceps, G. The median nerve, H, also lies behind it.

I. *Ulnar veins*. M, *basilic vein*, formed by the union of the median basilic with the ulnar veins. N, Internal cutaneous nerve.

FIG. 2. METHOD OF PERFORMING THE OPERATION.

The patient being either seated, or lying down, the operator having provided himself with a short bandage, places the centre of it upon the forepart of his arm, about three or four fingers' breadths above the bend of the elbow, and bringing its two ends to the outer side of the arm,



ties them in a bow-knot. Whilst the veins are swelling under the influence of this constriction, which, however, should never be carried so far as to control the beating of the pulse at the wrist, the surgeon prepares a small compress, folded in four, for the dressing, and makes ready his lancet, which is done by opening the blade until it forms a slightly obtuse angle with its handles; this he places within his reach, or between the teeth, so that it can be seized at any moment by the heel of the blade.

Then taking the patient's arm, he rotates it outwards, and places its hand beneath his own left arm (if it is upon the right arm that he is about to operate, and *vice versâ*, if on the left,); he now by means of gentle friction pushes along the blood so as to distend the portion of the vein which he is about to pierce, to the utmost, and confines it there by the thumb of his left hand across the vein, whilst the four fingers of the same hand encircle the back part of the patient's arm and their ends put the skin upon the stretch in front. This done, the surgeon takes the blade of the lancet between his thumb and index finger, and makes use of the other fingers as a point of support at the moment of piercing the vein, resting them upon the patient's forearm. The opening of the vein should be made, in most instances, by a simple puncture, obliquely to the general direction of the vein, *a, a', a''*. Immediately on the puncture being made, the stream of blood jets out with more or less force, and its force can be increased by causing the patient to grasp or squeeze in his hand a cane, lancet-case, or roll of bandage. When the requisite amount of blood has been obtained, it is arrested by applying the thumb of the left hand upon the opening in the vein, whilst removing the bandage from the arm. After having wiped away the blood from the arm, the small compress already prepared is placed upon the wound in the vein, under the thumb, and retained in its situation by a bandage applied around the arm in the form of the figure 8, the ends of which are tied in a knot over the wound, or fastened with a pin.

In bleeding from the arm there are several points worthy of notice, both with regard to the selection of a vein, and the shape of the lancet. Blood can be obtained from any of the veins at the bend of the arm when they can be recognized beneath the skin. The *median basilic*, *A*, or *cephalic*, *B*, are, however, for the most part preferred. What has been said above, applies particularly to the median cephalic; but when the median basilic is the only vein to be found, it is necessary for

the operator to ascertain accurately the position of the artery before opening the vein. It is better, as a rule, to make the puncture as low down in the vein as practicable, because, in this position, the aponeurotic expansion from the tendon of the biceps lies between the two vessels. If at the moment of puncturing the vein, the patient should throw his biceps muscle into a state of strong contraction, as he would, for example, in drawing the operator towards him with the arm, this, by throwing a stronger tension upon the aponeurotic expansion, would raise the median basilic vein, and separate it still farther from the artery which lies beneath it.

The lancet which makes an obtuse angle at its point, called *à grain d'orge*, from its resemblance in shape to a grain of barley, makes a large wound, and suits the great majority of cases (pl. 5, fig. 1); the more pointed pattern, known as the lancet *à grain d'avoine*, from its shape being like that of an oat-grain (fig. 2), and that with a very acute point, called *à langue de serpent* (fig. 3), from its likeness to a snake's tongue, are used when the vein lies very deep and is covered with a thick layer of fat; when using these it is recommended to enlarge the opening in the integuments by making the point of the instrument cut its way out by a lever-like movement succeeding the puncture. In this way a free flow of blood is secured, and the infiltration of the cellular tissue, known as *thrombus*, is prevented.

2D. BLEEDING FROM THE FOOT.

FIG. 3. ANATOMY OF THE PART.

The internal saphenous vein, A, which takes its origin on the dorsum of the foot, B, passes from below upwards in front of the internal malleolus, C, upon the inner side of the tibia, accompanied by the saphenous nerve, D. A thin layer of fascia separates it from the skin.

FIG. 4. MODE OF OPERATING.

The venous circulation in the foot is arrested, as in the arm, by means of a bandage placed around the ankle, about two fingers' breadths above the malleoli; after this it is placed in a warm foot-bath, whilst the lancet and dressing are being made ready. When prepared, the surgeon, seated in front of the patient, takes the foot from the water, and having wiped it places it upon his knee; he then secures

the vein, A, in its place with the thumb, as it is very apt to roll in this locality, and proceeds to open it precisely as in bleeding from the arm. It is rarely the case that the blood flows from the foot in a jet, and the custom is to replace the foot in the vessel of warm water until its deepened color, or the length of time of immersion, indicates that a sufficient quantity of blood has been lost.

The dressing consists of a small square compress over the wound, kept in place by a bandage in the form of the figure 8, around the foot and ankle.

PLATE V.

FIG. I. LANCETS.—1, À GRAIN D'ORGE ; 2, À GRAIN D'AVOINE ; 3, À
LANGUE DE SERPENT.

a, blade of the lancet ; *e*, heel of the blade ; *g*, sheath of the lancet ;
h, *h'*, the two portions of the sheath ; *f*, joint of the blade and its
sheath.

FIG. II. Bleeding from the external jugular vein, B ; arteriotomy
in the temporal artery, A.

BLEEDING FROM THE JUGULAR.

FIG. 2. ANATOMY OF THE PART.

The external jugular vein, which is sometimes solitary, and at others double in its origin, in the latter case commencing by two branches which unite in a common trunk about the middle of the neck, takes its course normally from the angle of the lower jaw to the middle of the clavicle. Passing obliquely backwards from its point of origin, it crosses the course of the sterno-cleido-mastoid muscle, and lies upon it, covered throughout by the platysma myoides and the skin. In the upper part of its course it has near it some small nervous filaments.

MODE OF OPERATING.

The patient being seated, or, still better, in reclining position, the circulation is arrested by a compress placed upon the vessel a short distance above the clavicle. The compress, which should be somewhat thick, is kept in its place by a bandage, A, which is tied in the arm-pit of the opposite side. A simple piece of cord, rather tightly tied, might readily take the place of the compress and bandage, for the cord buries itself in the skin and compresses the vein very accurately at the point where it is crossed. The vein being by this means sufficiently distended, the surgeon steadies it with his index finger, and makes the puncture, B. The opening in the vein in this region of the neck should be full

Fig 1



Fig 2



large, and directed obliquely across the fibres of the platysma muscle, for being thus divided the muscular fibres retract and keep the wound gaping. It happens very often that the blood will not flow in a jet, but trickles down the neck; in this case a common card should be folded longitudinally, so as to form a gutter, by which the blood can be guided into a proper vessel.

The flow of blood is stopped by removing the compression, and at the same time a finger should be placed upon the wound to prevent the entrance of air into the vein. The wound is dressed by bringing its edges together and applying a piece of adhesive plaster, or the common court plaster. Sometimes this dressing, and even the addition of a circular bandage, does not succeed in stopping the flow of blood entirely; in such a case M. Magistel suggests the introduction of a point of suture.

ARTERIOTOMY.

SURGICAL ANATOMY.

A' represents the course of the temporal artery; b', the section of the skin; c', pyramidal compresses for compression of the artery.

The temporal artery, a branch of the external carotid, when opposite to the condyle of the lower jaw, runs directly upwards behind the arch of the zygoma. About the middle of the temporal region it divides into two branches: the posterior, which passes backwards, and the anterior, or frontal, which runs upwards and forwards upon the forehead, where it lies upon the epicranial aponeurosis, and immediately beneath the skin.

MODE OF OPERATING.

The patient being properly placed, either sitting or lying, the exact position of the artery is ascertained by its pulsations, and it is steadied by the thumb and index finger of the operator, the skin covering it being rendered tense at the same time. He then, with a straight bistoury, held in the third position, makes a short incision directly across the course of the artery, by which it is divided. The blood issues sometimes in a jet, though more frequently it only trickles; in order to stop it, when necessary, compression is made on either side of the wound by means of the pyramidal compresses, c, c', which are retained in their places by a circular bandage around the head, knotted over the temples.

PLATE VI.

LIGATURE OF ARTERIES.

1ST. ON THE EFFECTS PRODUCED BY THE LIGATURE UPON AN ARTERY.

Fig. 1. Arteries are composed of at least three membranes placed one upon the other, called *coats*: *a*, the external coat, possesses the most vitality, is tough and very resisting; *b*, the middle coat, is yellow, elastic, composed of circular fibres, possesses very little power of resisting force applied in the direction of the course of the vessel, and a low degree of vitality; *c*, the internal coat, thin, smooth, transparent, endowed with little strength and no vitality, is regarded as an analogue of the epidermoid tissues.

Fig. 2. When a ligature, *a*, is applied to an artery, the internal and middle coats, *b*, *c*, are divided by the thread, and pushed aside, so that the internal surfaces, *c*, *d*, of the outer coat, the only one which resists the action of the ligature, are brought into forcible contact.

Fig. 3. After the application of a ligature to an artery, the first collateral branch, *a*, above the ligature becomes dilated; in the space between the ligature and this first collateral branch the blood stagnates, and shortly forms a clot, *b*, the office of which is to plug up the artery after the ligature has come away.

Fig. 4 and 5. The process of torsion, *a*, produces an effect upon the arterial coats analogous to the ligature, that is to say, it effects a division of the internal and middle coats, *b*, *b*, which are forced to either side, whilst the external coat, *c*, alone offers resistance, and becoming twisted, serves to obliterate the calibre of the artery.

Fig. 6. After the circulation of the blood through an artery has been interrupted, by a ligature or any other means, it becomes re-established beyond the obstruction by the dilatation of the anastomoses between the collateral branches above and below the ligature. Fig. 6, taken from Dupuytren's Museum, represents an aneurism, *a*, of the popliteal artery which was cured by the application of ice. We can readily recognize the very considerable dilatation of the articular arteries,

Pl. 6.

Fig 1



Fig 2

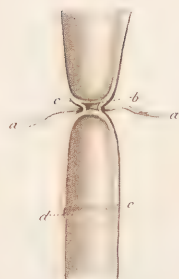


Fig 3



Fig 7

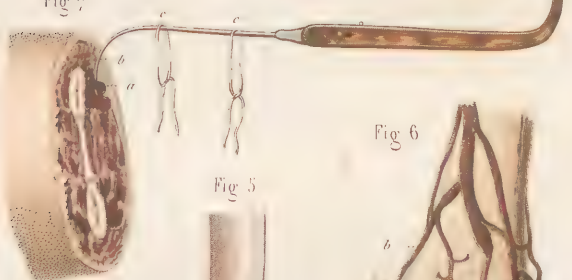


Fig 5



Fig 4



Fig 6



b, b, b, b, through which the circulation in the limb below has been preserved.

Fig. 7. *a*, an artery in a stump, transfixed by the point, *b*, of the tenaculum; *c, c'*, ligatures to be applied to the artery.

2D. GENERAL RULES FOR THE LIGATURE OF ARTERIES.

To lay bare an artery for the purpose of placing a ligature upon it it is necessary :

1st. To determine the position of the vessel, by the requisite familiarity with its anatomical relations, assisted by the arterial pulsations—if the operation is performed upon the living body.

2d. The skin being placed upon the stretch, an incision is made upon the vessel with a convex bistoury held in the third position; this incision, parallel with the course of the artery, should always divide both the skin and the subcutaneous cellular layer, and its length should be proportioned to the depth at which the vessel lies.

3d. The aponeurotic layer which binds down the muscles is to be divided to the same extent, on a director, and the muscles beneath pushed to either side to expose the sheath of the vessel, which contains the artery, in company with its corresponding veins and nerves.

4th. After raising a fold of the sheath of the vessel with the dissecting forceps, it is to be opened with great care, the edge of the bistoury being kept parallel to the artery, and never turned towards it.

5th. The bistoury is then relinquished, and the surgeon makes use of the director, held as a writing pen, to isolate the artery on either side, and endeavors with its point to tear through the loose cellular tissue which surrounds it, so as to pass the instrument behind the vessel. In this stage of the operation there are two important precautions to be observed; in the first place, to lay bare the artery to as trifling an extent as possible, and secondly, to introduce the director between the artery and the vein, so that the latter shall not be exposed to injury from the point of the director as it passes beneath the artery.

6th. When the artery is well exposed and the director lodged beneath it, the operator satisfies himself of its identity by recognizing its pulsations, and then passes along the groove of the director an eyed-probe, armed with the ligature. When the vessel is deeply situated, Deschamps' or Cooper's artery-needle is substituted for the eyed-probe.*

* The highest American authority in regard to the mode of tying arteries, Prof. Mott, does not make use of the director as described above, but employs in its

Finally, being assured of the identity of the artery, the first knot in the ligature is tied. If the vessel is deeply placed, the knot should be tightened by means of the two index fingers inserted into the wound, one of them pressing upon each end of the ligature, in order that the artery should not be too much dragged from its bed. The second knot is then tied, one of the ends of the ligature cut off, and the remaining one brought out at the most depending angle of the wound.

place the smooth round point of the artery-needle which bears his name, and which is also known as the American needle. After opening the sheath of the vessels, and separating it from the artery with the handle of the scalpel, he insinuates the point of this needle, which he considers by far the best instrument of its kind, gently between the vein and artery, and passes it beneath the latter, always keeping the point *from the vein*, and disturbing the connections of the artery as little as possible. As there is probably no surgeon living who has operated upon the arteries more extensively, or more successfully, than Prof. Mott, we can do no better than to follow his method in this respect.—Eds.



PLATE VII.

LIGATURE OF THE ULNAR AND RADIAL ARTERIES.

FIG. 1. SURGICAL ANATOMY.

A, Brachial artery, accompanied on its inner side by the median nerve, *b*.

c, median basilic vein, crossing the course of the brachial artery and median nerve, from which it is separated by the aponeurotic expansion, *d*, given off by the tendon of the biceps.

Incision No. 2 represents the *ligature of the ulnar artery in its lower third*, *a*, incision in the skin; *b*, edges of the divided aponeurosis; *c*, ulnar nerve; *d*, tendons of flexor *sublimes*; A, radial artery with the director beneath it.

Incision No. 3. *Ligature of the radial artery in its upper third*. *a*, wound in the skin; *b*, edges of the aponeurosis; *c*, radial nerve; *d*, internal border of the *supinator longus*; A, radial artery with the director beneath it.

Incision No. 4. *Ligature of the radial artery at the wrist*. *a*, wound in the skin; *b*, aponeurosis; *c*, radial nerve; A, radial artery on the director.

MODE OF OPERATING.

§ 1. *Ligature of the radial artery at the wrist* (see incision No. 4). 1st, Along the external border of the tendon of the *flexor carpi radialis*, which is always easily recognized, make an incision from one and a half to two inches in length through the skin and sub-cutaneous cellular tissue. 2d, Divide the aponeurosis of the fore-arm upon a director; recognize, isolate, and place a ligature beneath the artery, which is situated just external to the tendon of the *flexor carpi radialis*, always easily known by its pearly color.

§ 2. *Ligature of the radial artery in the upper third of the fore-arm*—(see incision No. 3).

Upon the internal border of the *supinator longus* muscle, if it can be recognized, and if not, along a line, representing the course of the

artery, and drawn from the middle of the bend of the elbow, to the inner side of the styloid process of the radius, let an incision be made from two and a half to three inches in length, taking care to avoid the superficial veins. The deep fascia being laid open on the director, the inner edge of the supinator longus muscle is to be sought for beneath it. This landmark being determined, on drawing the muscle a little outwards with a spatula or blunt hook, the artery will be discovered enclosed in its sheath with its two *venæ comites*, from which it is to be isolated and tied.

§ 3. *Ligature of the ulnar artery in the lower third of the forearm* (see incision No. 2). 1st. Along the external border of the tendon of the *flexor carpi ulnaris*, or if it is preferred, in the course of a line drawn from the internal condyle of the humerus to the prominence of the pisiform bone, let fall an incision from one and a half to two inches in length, dividing the skin and subcutaneous cellular tissue; 2d. The deep fascia being then laid open upon the director, the tendon of the *flexor ulnaris* will be seen, and it must be pushed towards the inner side; 3d. The artery, which is beneath it, between its two accompanying veins in their common sheath, is then to be isolated, and the ligature inserted beneath it.

§ 4. *Ligature of the ulnar artery in the middle of the forearm* (see incision No. 1). 1st, Upon the imaginary line just indicated make an incision three inches in length through the skin and cellular tissue; 2d, endeavour to find the first intermuscular septum which can be detected, going from within outwards; 3d, divide it upon the director, and push the fibres of the *flexor sublimis* towards the outer side of the limb, when the artery will be discovered immediately beneath it, with its veins. After having laid open the sheath of the artery, it will be found most convenient to make use of Cooper's or Deschamps' needle, on account of the depth of the wound.



Fig 1

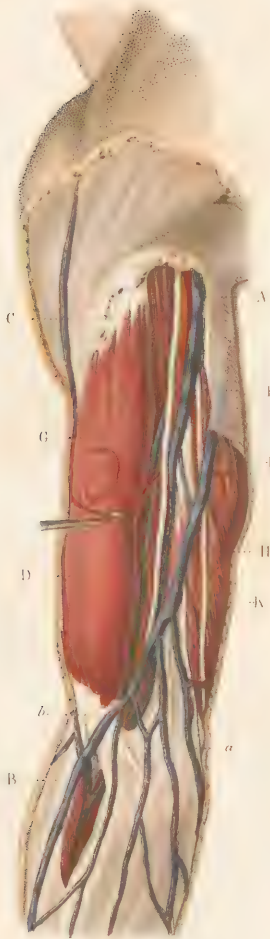


Fig 2

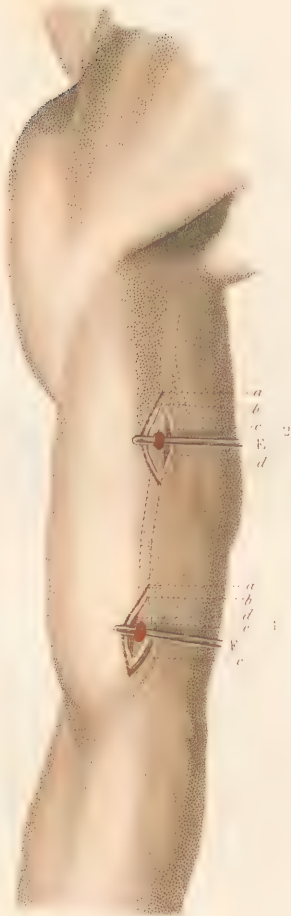


PLATE VIII.

LIGATURE OF THE BRACHIAL ARTERY.

FIG. 1. SURGICAL ANATOMY.

AB, *Brachial artery*.—It extends from the inferior limit of the axilla to about an inch below the articulation of the humerus with the ulna. Situated on the inner side of the humerus above, it inclines gradually outwards in descending the arm, and at its lower part lies in front of the bone.

In its upper fourth the artery is in relation with the inner edge of the *coraco-brachialis* muscle C; below, it corresponds with the internal border of the *biceps*, D, which slightly overlies it in its two inferior thirds. In emaciated subjects it is covered only by the integuments and deep fascia of the arm. Towards its termination, it lies along the inner edge of the tendon of the *biceps*, whilst about to pass beneath the aponeurotic expansion, *a*, given off by the latter, which separates it from the median basilic vein, *b*.

E, *The median nerve*, which accompanies the artery throughout its course, enclosed with it in a common aponeurotic sheath. Above, the nerve is external to the artery; towards the middle of its course, it passes in front, and below, in its inferior third, it lies internal to it. The *radial and ulnar nerves* lie behind, and to the inner side of the artery, but only at its upper part.

FG, *Humeral veins*.—The vein on the inner side of the artery is larger than that on the outer side; in their course down the arm, they form frequent anastomoses with each other.

H, *The inferior profunda*, branch of the brachial artery which passes backwards in company with the ulnar nerve, K.

FIG 2. OPERATION.

Incision No. 1. *Ligature of the brachial artery near the bend of the elbow.* *a*, incision involving the skin and cellular tissue; *b*, edges of the divided aponeurosis of the arm; *c*, median basilic vein, situated between the skin and aponeurosis, and pushed out of its place towards

the inner condyle; *d*, inner edge of the *biceps* muscle; *e*, median nerve on the inner side of the artery; *F*, artery isolated from its sheath, with the director beneath it.

Incision No. 2. *Ligature of the brachial artery at the upper part of the arm.*—*a*, incision through the integuments; *b*, incision of the deep fascia; *c*, brachial vein; *d*, median nerve, external to the artery; *E*, artery isolated, and raised upon the director.

MODE OF OPERATING.

§ 1. *Ligature of the brachial artery at the bend of the elbow* (see incision No. 1). 1st, Make out distinctly the tendon of the *biceps*, and the internal border of this muscle.

2. Make an incision at least two inches long, following the curve of the inner edge of the *biceps*. In this incision through the integuments, the precaution must be taken to push the basilic vein on one side, in order that it may not be wounded.

3. The deep fascia, in this situation, is the aponeurotic expansion given off by the tendon of the *biceps*; it is to be laid open on the director.

4. Beneath it is seen the artery with its veins, and on its inner side, the median nerve; the sheath is to be opened by cutting upon it obliquely, and the artery carefully isolated and tied.

§ 2. *Ligature of the brachial artery in the upper part of the arm* (see incision No. 2). 1st, after having distinctly recognized the internal border of the *biceps* muscle, make an incision parallel to it about two inches and a half in length, through the skin and cellular tissue.

2d. Lay open the deep fascia on a director.

3d. Look for the nervous trunk which lies nearest the inner edge of the *biceps*; it is the median nerve, beneath and to the inner side of which the artery will be found.

4th. Open the common sheath of the vessels, by lifting a fold of it with the forceps and holding the knife horizontally; then push the median nerve outwards, isolate the artery, and pass the director beneath it from without inwards.

Fig 1

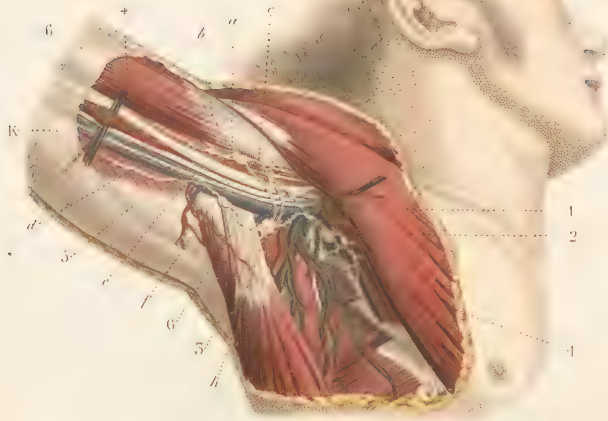


Fig 2.

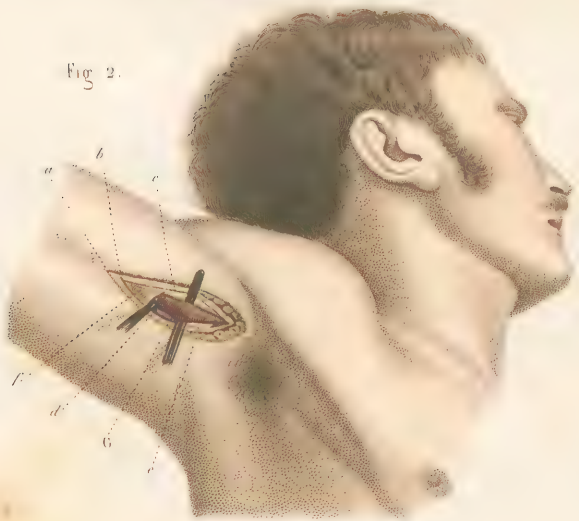


PLATE IX.

LIGATURE OF THE AXILLARY ARTERY.

FIG. 1. SURGICAL ANATOMY.

1, *Pectoralis major* muscle drawn upwards; 2, *pectoralis minor*; 3, *Latissimus dorsi* and *teres major* muscles; 4, *biceps* muscle; 5, *triceps extensor cubiti*; 6, deep fascia of the arm.

a, *Axillary artery*. A continuation of the subclavian artery, it commences at the lower border of the first rib, and ends at the inferior boundary of the axilla (the lower border of the *latissimus dorsi* muscle); its course corresponds with a line dividing the anterior from the middle third of the axilla. In its inferior half it is in relation externally with the inner side of the humerus, against which it may be readily compressed; internally it is covered only by the integuments and deep fascia, and its pulsations can be easily felt.

b, *coraco-brachialis* muscle, in contact with the artery throughout its course. The artery is always to be found at the internal and posterior border of this muscle, which serves as a reliable landmark.

c, d, e, f, *branches of the brachial plexus of nerves*. They surround the artery very closely below the *pectoralis minor* muscle; c, the *musculo-cutaneous* nerve lies along the outer side of the artery; d, the median, the largest branch of the plexus, takes its origin by two roots, which meet in front of the artery, opposite the lower border of the *pectoralis minor* muscle; this nerve, skirting along the inner border of the *coraco-brachialis* muscle, lies in front and a little to the outer side of the artery; e, *internal cutaneous* nerve, a small branch which takes its origin from the innermost root of the median, lies in front and to its inner side. Finally, the *ulnar* nerve, f, and the *radial*, which is concealed by the axillary vein, are situated still farther within and behind.

G, the axillary vein, is situated in front of the artery and nerves, which it partly conceals.

The axillary vessels and nerves are surrounded and held together by

a loose cellular tissue, which is interspersed with numerous lymphatic vessels and glands, *h*.

I, the subscapular, and inferior thoracic arteries and veins.

K, brachial artery, continuation of the axillary, isolated from the nerves and veins which surround it.

FIG. 2. OPERATION.

a, incision of the skin, cellular and adipose tissues; *b*, deep fascia; *c*, median nerve, pushed upward; *d*, axillary vein, depressed by a blunt hook; *e*, internal cutaneous nerve; *f*, sheath of the axillary vessels; G, axillary artery upon the director, which has been passed from within outwards, and from below upwards.

MODE OF OPERATING.

The operation of tying the axillary artery in the axilla, below the *pectoralis minor* muscle, is described as Lisfranc's method; it is as follows: 1st, determine the position of the artery by drawing a straight line corresponding with the union of the anterior third with the posterior two-thirds of the axilla, or by feeling, if possible, for the internal edge of the *coraco-brachialis* muscle, the guide for the artery. 2d, carefully divide the skin and cellular tissue on this line to the extent of two inches and a half. 3d, as soon as the fasciculus of vessels and nerves is in sight, lay aside the bistoury, and relax the parts by slightly lowering the arm. 4th, endeavor then to recognize the *coraco-brachialis* muscle, and make use of it as a guide to the position of the artery. 5th, by the aid of the director, starting from the *coraco-brachialis* muscle, first push the median and internal cutaneous nerves in front, and then the ulnar and musculo-spiral towards the posterior border of the wound; in the interval between them the artery and vein will be found. 6th, separate with care the artery from the vein, and pass the needle beneath it, from behind forwards, in order not to injure the vein, which in this locality requires more care than the nerves.



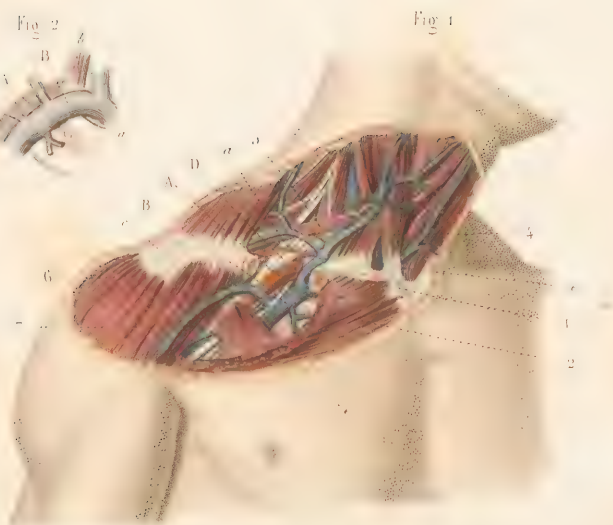
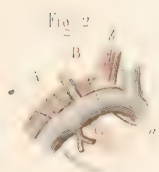


PLATE X.

LIGATURE OF THE AXILLARY AND SUBCLAVIAN ARTERIES.

(For the origin and collateral branches of the subclavian arteries, see pl. 11.)

FIG. 1 AND 2. SURGICAL ANATOMY.

FIG. 1. 1, the clavicle and *pectoralis major* muscle, cut away partially, 2, in order to expose the axillary vessels; 3, the *trapezius* muscle; 4, sterno-mastoid; 5, omo-hyoid; 6, deltoid; 7, *pectoralis minor*.

A, the axillary artery; in its upper half, it is covered successively by the insertion of the *pectoralis minor*, 7, higher up by the *pectoralis major* muscle, from which it is separated by a layer of adipose tissue, containing numerous small veins and arteries; and finally by the fascia and the skin. *a*, The supra-scapular artery which crosses the base of the neck just above the clavicle.

B, the *axillary vein*, situated in front and to the inner side of the artery, is not in immediate contact with it. The *cephalic vein*, *c*, passes upward in the interspace between the deltoid and *pectoralis major* muscles, crosses the axillary artery above the superior border of the *pectoralis minor*, and empties into the axillary vein.

D, the *nerves of the brachial flexus*, lie behind and above. A thoracic branch often crosses the course of the artery, sometimes in front, and sometimes behind it.

FIG. 1 and 2. A, the *subclavian artery*, taking its origin from the innominate on the right side, and from the arch of the aorta on the left, passes upwards, curves in the form of an arch over the first rib, *a*, and runs downwards and outwards to the first intercostal space, where it takes the name of *axillary artery*. On account of the difference in their origin it will be seen that the first, or ascending portion of the left subclavian, is somewhat longer than the corresponding division of the right. (See pl. 11, fig. 1.)

The *subclavian artery*, after passing between the scaleni muscles, runs downwards upon the first rib, *a* (fig. 2), in a groove situated just

outside of the tubercle into which the *scalenus anticus* muscle, *b*, (fig. 2,) is inserted, which tubercle Malgaigne pointed out as an excellent landmark in searching for the artery. Beyond the *scaleni* the artery lies in the supra-clavicular triangle, which is bounded below by the clavicle and the *subclavius* muscle; within, by the sterno-mastoid, 4, which often overlies it slightly with its external border; and on the outside by the *omo-hyoideus*. Here the artery is covered only by the deep cervical fascia, the platysma myoides muscle, and the skin; still lower in its course it is covered by the clavicle and *subclavius* muscle. In persons with long necks the first rib rises above the clavicle, and in this case the artery may be readily compressed directly against it by pushing the clavicle slightly downwards.

B, the *subclavian vein*, situated somewhat lower down and in front of the artery, is separated from it by the insertion of the *scalenus anticus* muscle, *b*, fig. 2. The external jugular vein, *e*, may cross in front of the artery whilst passing down to empty into the subclavian vein.

D, the *nerves of the brachial plexus*, lie above and behind the artery; they are only in relation with it below and posteriorly.

FIG. 3. OPERATIONS.

Incision No. 1. *Ligature of the axillary artery*.—*a*, incision of the skin; *b*, deep fascia; *c*, upper border of the *pectoralis minor*; *e*, fibres of the *pectoralis major* cut across; *d*, axillary vein; A, axillary artery, below the point where the cephalic vein empties into the subclavian, with an artery needle passed beneath it.

Incision No. 2. *Ligature of the subclavian artery outside of the scaleni*.—*a*, incision in the skin; *b*, deep fascia; *c*, omohyoid muscle; *d*, nerves of the brachial plexus; *e*, *scalenus anticus* muscle; *f*, subclavian vein; A, subclavian artery.

MODES OF OPERATING.

§ 1. *Ligature of the axillary artery below the clavicle.*

1. *Ordinary method*.—The muscles of the shoulder being perfectly at rest, the elbow slightly separated from the trunk, and the head inclined to the opposite side, the surgeon makes, from eight to ten lines below the clavicle, and parallel with it, an incision involving the skin, platysma and subcutaneous cellular tissue, and extending from the septum between the *pectoralis major* and deltoid muscles, to a point two

fingers'-breadth outside of the sterno-clavicular articulation. The muscular fibres of the *pectoralis major* being successively divided and pushed aside, the posterior fascial investment of this muscle (the coraco-clavicular aponeurosis) is brought into view. Then, to favor the separation of the edges of the wound, the shoulder should be depressed, and the fascia torn through with the point of a director. The finger being introduced into the wound to press downwards and outwards the *pectoralis minor* muscle, the following parts can be recognized: 1st the vein, distended with blood; 2d, the axillary artery, farther on the outside and behind it; 3d, the nerves of the brachial plexus, situated still higher up and farther behind. Whilst passing the ligature beneath the artery, it is important that the vein should be pressed to the inner side by the finger, in order that it may be protected from injury from the point of the director, or needle, as it is introduced between the vessels.

By this method, the artery is tied in a triangular space which is bounded above by the clavicle, below and on the outer side by the *pectoralis minor* muscle, and below and on the inner side by the sternal portion of the *pectoralis major*.

II. *Desault's method*.—This consists in making an oblique incision, about three inches in length, following the interspace separating the deltoid and *pectoralis major* muscle, which contains some cellular tissue and fat, as well as the cephalic vein, which must be carefully avoided. The object in this operation is to reach the axillary artery below the *pectoralis minor* muscle.

III. *Chamberlayne's method*.—Make an incision three inches in length below the clavicle, and join it by another of the same extent, corresponding to the interspace between the deltoid and *pectoralis major* muscle. This method, as is seen, unites the incision employed by Desault, with that of the ordinary method. The result is a triangular flap which is to be turned downwards in proceeding with the operation. The ligature of the axillary artery above the *pectoralis minor* muscle can be effected with much more facility by the double incision of Chamberlayne, than by the ordinary method, and is therefore preferable to it.

§ 2. *Ligature of the subclavian artery*.—A ligature may be applied to the subclavian artery at three different points in its course: 1st, on the *outside* of the *scaleni* muscles, upon the first rib; 2d, *between* the *scaleni*, behind the insertion of the *scalenus anticus*; 3d, *within* the

scaleni. In the first two of these operations the artery is sought for in the supra-clavicular triangle already described.

I. *On the outside of the scaleni.*—*Velpeau's method.*—1st, The patient being situated conveniently, a transverse incision is to be made above the clavicle, and parallel with its posterior border, extending from the sterno-mastoid muscle to the anterior edge of the trapezius. The skin, platysma, and cellular tissue are to be divided, layer by layer, and the external jugular vein, if it cannot be avoided, must also be cut across, after being tied above and below; 2d, the cellular and fatty tissue is now to be torn and pushed aside with the point of the director, until the finger can detect, at the bottom of the wound, the *tubercle on the first rib*, into which the *scalenus anticus* is inserted; 3d, this landmark being well recognized, introduce upon the finger the point of an artery needle, from before backwards, and slightly from without inwards, so that it may pass beneath the artery, preventing, at the same time, with the point of the finger, the artery from being pushed by the needle towards the first trunk of the brachial plexus. In order to facilitate this manœuvre, the shoulder should be depressed as much as possible.*

II. *Between the scaleni;*—*Dupuytren's method.*—This operation differs from the latter only in the situation of the ligature, which is to be placed on that portion of the artery which lies between the two *scaleni* muscles. To accomplish this, after the operator has recognized the situation of the tubercle on the first rib, and has felt distinctly the insertion of the muscle into it, he passes a director beneath the latter, between it and the artery, and on the director divides the muscle across. Thus, by the retraction of its muscular fibres, the artery is exposed, and a ligature is readily carried around it. The objections are urged against Dupuytren's operation: that in it the phrenic nerve, which lies along the inner margin of the *scalenus anticus*, is exposed to injury, as well as the subclavian vein, and the origin of the internal mammary artery, which lie in its immediate vicinity.†

* This operation was first performed by Mr. Ramsden, of St. Bartholomew's Hospital, London, in 1809; his patient died on the fifth day. It was first successfully performed by Prof. Wright Post, in this city, in 1817.

† The successful termination of this operation in Dupuytren's case, as well as more recently in the hands of Dr. J. C. Warren, of Boston, renders it desirable to obviate these objections if possible, especially as in some cases it may be substituted for the ligature of the artery within the *scaleni*, which is such a desperate resource. Prof. Mott proposes to avoid some of the dangers enumerated above, which, by the

III. *Within the scaleni*.—Colles, Mott, and Liston have each placed a ligature upon the artery in this situation, but thus far it has not been followed by success. The operation presents so many serious difficulties, on account of the great depth of the artery, its numerous branches, and the importance of the parts by which it is surrounded, that it is at present hardly considered a justifiable undertaking.*

way, are not alluded to by any of the surgeons who have successfully performed the operation, by cutting through the *scalenus anticus* muscle vertically, in the direction of its fibres, to a sufficient extent, and passing a ligature around the artery through the opening thus made.—Eds.

* The mode of operating adopted for the ligature of the *right* subclavian artery within the *scaleni*, is very much the same as that for the ligature of the *arteria innominata*, to be shortly described. A similar method was also employed by Dr. J. Kearny Rodgers, for the ligature of the *left* subclavian within the *scaleni*, an operation never before attempted until performed by him at the New-York Hospital in 1846. The result of the case was unsuccessful.—Eds.

PLATE XI.

LIGATURE OF THE PRIMITIVE CAROTID, LINGUAL AND
FACIAL ARTERIES.

FIG. 1, 2 AND 3. SURGICAL ANATOMY.

FIG. 1. *Origin of the carotid and subclavian arteries ; branches of the subclavians.*—*a, a*, arch of the aorta ; *b*, *innominata* ; *d, c*, right subclavian and carotid, arising from the *innominata* ; *e, f*, left subclavian and carotid. On the inner side of the *scalenus* muscle, *g*, on either side, the subclavians give off the following branches : the vertebral arteries, *h, h* ; the inferior thyroid and supra-scapular, arising generally from a common trunk, the thyroid axis, *i, i* ; the internal mammary arteries, *j, j*. Beyond the *scalenus* arise : the posterior scapular branches, *k, k* ; and the acromio-thoracic artery, which, however, is more frequently given off by the axillary artery, just above the *pectoralis minor* muscle.

FIG. 2. *Relations of the arterial with the venous trunks.*—*a, a*, internal jugular veins, somewhat in front of and external to the carotids ; *b, b*, the subclavian veins, in front of, running parallel with, and somewhat lower down than their corresponding arteries ; *c*, the *vena innominata* in front, and a little on the outside of the artery of the same name ; *d*, the left brachio-cephalic venous trunk, or *vena innominata*, crosses in front of the origins of the left subclavian and carotid, and the arch of the aorta ; *e*, inferior thyroid vein ; *f*, external jugular.

FIG. 3. 1, sterno-thyroid muscle ; 2, omo-hyoid ; 3, 3, extremities of the sterno-mastoid muscle, which has been cut across ; 4, masseter.

A, right primitive carotid. Extending from the bifurcation of the *innominata* to the upper border of the thyroid cartilage, it ascends the neck somewhat obliquely from before backwards, and from within outwards, skirting along the outer side of the trachea and larynx, and lying upon the *longus colli* and *rectus anticus major* muscles. In its lower half it is covered in front by the sterno-hyoid and sterno-thyroid muscles, 1 ; near its middle it is crossed by the omo-hyoid muscle, 2 ; and below this point it is also overlaid by the sternal portion of the

Fig 5.



Fig 4



sterno-mastoid, by which it is separated from the platysma and integuments, the platysma covering the artery only in its upper half.

B, the *internal jugular vein*, which lies on the outside of the artery, and over-lays it slightly.

C, the *pneumogastric nerve*, which lies behind the vein and artery and between them, in the same sheath; below, it passes between the subclavian artery and vein to enter the thorax. Several cardiac branches arise from it, which cross in front of the artery in its lower fourth.

The *great sympathetic nerve* lies still further behind the vessels, in the loose cellular tissue between their sheath and the provertebral muscles, in company with some lymphatic vessels and glands.

D, the *internal carotid*, and D' the *external carotid*, are the terminal branches of the primitive trunk. The external carotid, lying in front of the internal, terminates opposite the articulation of the lower jaw, where it takes the name of *temporal*. Almost superficial at its origin, it is immediately afterwards crossed by the *great hypoglossal nerve* H, and stylo-hyoid and digastric muscles, when it enters the substance of the parotid gland.

E, the *facial artery*, arising from the external carotid, a little above the *cornu* of the *os hyoides*, passes beneath the stylo-hyoid and digastric muscles, through the submaxillary gland, and by a flexuous course reaches the base of the lower jaw, over which it mounts, lying in the interspace between the *triangularis oris* muscle, and the anterior border of the masseter, whence it passes on to supply the face.

F, the *lingual artery*, arising from the external carotid below the facial, and opposite to the *os hyoides*, over which it winds to bury itself in the tongue. At its origin it is crossed by the *great hypoglossal nerve* H.

FIG. 4. OPERATIONS.

Incision No. 1. *Ligature of the facial artery*.—a, incision in the skin; b, edges of the platysma and deep fascia; A, facial artery, beneath which a ligature has been passed.

Incision No. 2. *Ligature of the lingual artery*.—a, incision through the platysma and deep fascia; c, incision in the *genio-hyo-glossus* muscle; A, lingual artery with the ligature beneath it.

Incision No. 3. *Ligature of the carotid in its middle portion*.—a, incision of the skin; b, deep cervical fascia; A carotid artery, with the director beneath it.

MODES OF OPERATING.

§ 1. *Ligature of the innominata.* This artery takes its origin from the most anterior point of the arch of the aorta, and after ascending obliquely from an inch to an inch and a half, terminates opposite to the right sterno-clavicular articulation. Although so short and deeply situated, this artery has nevertheless been tied in the living body, without excessive difficulty, by Mott, who employed the following steps in the operation.

Mott's method. 1st, The patient lying conveniently, with his head thrown backwards, an L shaped incision is made, the horizontal portion of which extends parallel with the clavicle, and about half an inch above it, from the median line of the neck three inches outwards, whilst the vertical portion follows the internal edge of the right sterno-mastoid muscle to the same extent.

2d. The whole of the sternal portion, and the greater part of the clavicular insertion of the sterno-mastoid muscle, is then cut across and turned over the flap, and the sterno-hyoid and sterno-thyroid muscles thus brought into view, are divided in the same manner, and turned over upon the trachea; 3d, the carotid being now recognized, is followed down to its origin; 4th, the *innominata* being laid bare to the necessary extent, carefully avoiding the pneumogastric and phrenic nerves, as well as the internal jugular vein and the pleura, pass the ligature in an appropriate artery needle, from below upwards, and from without inwards.

§ 2. *Ligature of the primitive carotid artery at the middle of the neck.* (Pl. 16, fig. 2). 1st, The patient being placed in a recumbent position, and the head turned to the opposite side, an incision three inches in length is to be made along the inner border of the sterno-mastoid muscle, and carried through the skin, subcutaneous cellular tissue, and *platysma myoides*. 2d, Divide upon a director that portion of the deep cervical fascia, which unites the edges of the sterno-hyoid and sterno-thyroid muscles, with the sterno-mastoid; 3d, flexing the patient's head forward, and separating the muscles just named, the omo-hyoid is brought into view crossing the wound obliquely, this may be pushed upwards, or downwards, or cut across, if in the way; 4th, the sheath of the vessel is now visible, this is to be opened with care, upon a director, whilst an assistant presses upon the vein at the upper angle of the wound, to prevent its extreme distention from interfering with the

operator; 5th, the cellular tissue connecting the vessels is then to be gently torn with the point of the needle, in order that it may be passed beneath the vessel, from without inwards.

Ligature of the primitive carotid at the base of the neck.—Malgaigne's method.—1st, Make an incision from two and a half to three inches in length, extending from a point one-third of an inch above the sterno-clavicular articulation, upwards in the direction of a line which, if produced, would meet the symphysis of the chin; 2d, the skin, cellular tissue, and deep cervical fascia being divided, the sternal insertion of the sterno-mastoid muscle is laid bare; 3d, divide this in the direction of the external incision, and beneath it will be found the sterno-hyoid and sterno-thyroid muscles, which are to be pushed inwards towards the trachea; 4th, the sheath containing the vessels is now in view, and it should be opened, in the usual manner, as near to the trachea as possible, in order to avoid the vein.

§ 3. *Ligature of the lingual artery.—Malgaigne's method.*—(Pl. 11, fig. 4.) 1st, Having recognized the position of one of the greater *cornua* of the hyoid bone, make an incision about an inch in length parallel with, and about two lines above it, through the skin, cellular tissue, and platysma; 2d, this incision will expose the lower border of the submaxillary gland, on lifting which slightly, the shining tendon of the digastric will be recognized; 3d, less than a line below this lies the great hypoglossal nerve, and at the distance of a line below the nerve, a transverse incision through the fibres of the *genio-hyo-glossus* muscle, will certainly expose the artery, which in this situation is accompanied by neither vein nor nerves.

§ 4. *Ligature of the facial artery as it crosses the lower jaw.*—(Pl. 11, fig. 4.) 1st, Let the patient close his jaws firmly, and feel with the finger for the anterior border of the masseter muscle, where the pulsations of the vessel can generally be distinguished; 2d, make over this point a vertical incision an inch in length, down to the fibres of the masseter; 3d, at its anterior edge the vessel will be found, resting immediately upon the bone, in company with its vein, the artery being nearer the median line. In isolating the artery the cellular tissue around it will be found to be somewhat dense.

PLATE XII.

LIGATURE OF THE RADIAL, AND DORSALIS PEDIS ARTERIES.

FIG. 1. SURGICAL ANATOMY OF THE RADIAL ARTERY AT THE WRIST.

1. Posterior annular ligament of the carpus; tendons of the *extensor ossis metacarpi pollicis*, 2; *extensor primi internodii*, 3; and *extensor secundi internodii pollicis*, 4.

A, the radial artery (see pl. 7, fig. 1), opposite the radio-carpal articulation, winds around the styloid process of the radius to the back of the wrist, and passes beneath the united tendons, 2, 3, of the *extensor ossis metacarpi*, and *extensor primi internodii pollicis*; it then descends a little obliquely beneath the tendon of the *extensor secundi internodii pollicis*, and plunges through the first interosseous space of the metacarpus to the palm of the hand, where it terminates by forming the deep palmar arch.

In this course it is accompanied by its veins, and some small branches of the radial nerve; it is covered by the deep fascia of the limb, and the integuments.

FIG. 2. OPERATION.

a, incision in the skin; b, deep fascia; A, radial artery.

FIG. 3. SURGICAL ANATOMY OF THE ARTERIA DORSALIS PEDIS.

1. Anterior annular ligament of the tarsus; 2, tendon of the *extensor proprius pollicis pedis*; 3, tendons of the *extensor longus digitorum pedis*; 4, *extensor brevis digitorum pedis*.

A, the *arteria dorsalis pedis*, a continuation of the anterior tibial, commences beneath the anterior annular ligament of the tarsus, 1, midway between the malleoli, and extends to the commencement of the first interosseous space, where it passes directly downwards to the sole of the foot, and anastomoses with the plantar arch.

Covered by a layer of aponeurosis which binds it down upon the bones of the tarsus, and above this by the fascia of the limb, and the

Fig 1

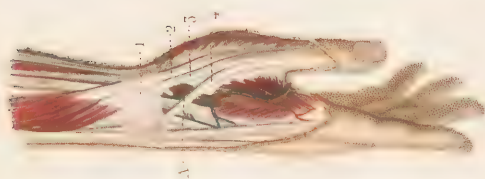


Fig 2

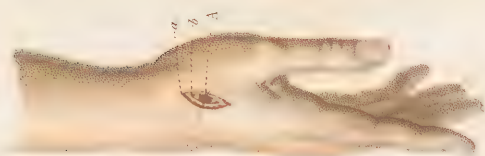


Fig 3

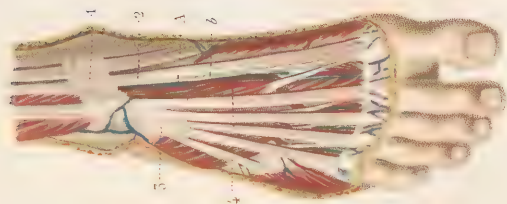
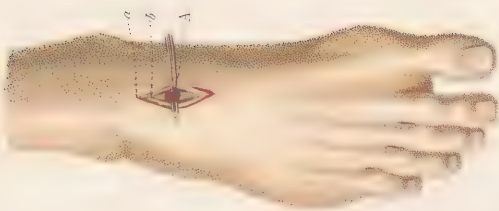


Fig 4



skin, the *dorsalis pedis* descends upon the instep, accompanied by its two *venæ comites*, and the anterior tibial nerve *b*, on its inner side. It runs along the outer edge of the tendon, 2, of the *extensor proprius pollicis*, an important relation, which offers an invariable guide to the artery by placing the great toe in the extended position. On its outer side it is in relation with the *extensor brevis digitorum pedis*, 4, which in muscular subjects overlays it to some extent.

FIG. 4. OPERATION.

a, incision in the skin; *b*, incision in the aponeurosis; *A*, *arteria dorsalis pedis* upon the director.

MODES OF OPERATING.

§ 1. *Ligature of the radial artery at the wrist.—Ordinary method.*—1st. By forced extension of the thumb determine the position of the tendon of the *extensor secundi internodii*; 2d, make an incision about an inch in length along the inner border of this tendon and parallel to it, the centre of which shall correspond to the proximal end of the first interosseous space; 3d, incise the deep fascia in a slanting direction; 4th, beneath this, in the angle at the extremity of the first interosseous space, the artery will be found lying upon the bone between its two veins; isolate it with the point of the director, and pass the ligature beneath it.

§ 2. *Ligature of the dorsalis pedis.*—1st, Make an incision about two inches in length about the middle of the instep, in the course of a line drawn from midway between the two malleoli to the upper end of the interosseous space, between the first two metatarsal bones, along the external border of the tendon of the *extensor proprius pollicis pedis*, and parallel to it; 2d, divide the deep fascia upon a director; 3d, endeavor to recognize the innermost division of the *extensor brevis digitorum*, and lay open the aponeurotic sheath of this muscle; 4th, beneath this, the artery will be found lying upon the bone, between its two veins, from which it is to be isolated and tied in the usual manner.

PLATE XIII.

LIGATURE OF THE ANTERIOR TIBIAL ARTERY.

FIG. 1. SURGICAL ANATOMY.

1. Patella; 2, external malleolus; 3, external aponeurosis of the limb; 4 and 5, *tibialis anticus* and *extensor longus digitorum* muscles, separated by blunt hooks, exposing the vessels deeply situated between them; 6, *peroneus longus* and *brevis* cut across; 7, fibula.

A, the anterior tibial artery, the external and anterior branch of the popliteal, takes its origin beneath the tendinous arch uniting the two heads of the *soleus* muscle, and terminates in the *dorsalis pedis*, under the anterior annular ligament of the tarsus. Its direction, which is slightly oblique from above downwards and from behind forwards, would be represented by a line drawn from the centre of the space between the head of the fibula and tuberosity of the tibia, to the centre of the inter-malleolar space on the front of the ankle. The artery passes through the interosseous ligament in the upper fourth of the limb, to its anterior surface, and lies upon it in the upper two-thirds of its course; below this it lies upon the anterior face of the tibia. In the upper half of its course it lies deeply, between the *tibialis anticus* 4, and *extensor longus digitorum*, 5; in its lower half it is more superficially situated between the *tibialis anticus* 4, and *extensor proprius pollicis* 8, which latter muscle crosses it from without inwards, anteriorly, as it passes to its destination; the artery then skirts along the outer side of its tendon, and passes beneath the anterior annular ligament, in the same tendinous sheath.

The *extensor longus* and *tibialis anticus* muscles take their origin partly from the deep fascia in the upper part of the leg, 3, and this arrangement renders it difficult to recognise the intermuscular septum before dividing it freely, and also interferes with the ready separation of the muscles.

B, B, the *anterior tibial veins*, which accompany the artery throughout its course.

Fig. 1.



Fig. 2.



C, anterior tibial nerve; at first it lies external to the artery, afterwards crosses it in its lower fourth, and lies internal to it under the anterior annular ligament of the tarsus.

A', the peroneal artery, the most external and posterior branch of the popliteal, runs down the posterior face of the fibula to the *os calcis*, covered above by the *solæus* muscle; lower down it lies between the *flexor longus pollicis*, 9, and the *tibialis posticus* muscles; and in its lower fourth lies upon the interosseous ligament.

FIG. 2. OPERATION.

Incision No. 1. *Ligature of the anterior tibial artery below its middle.*—*a*, incision in the skin; *b*, deep fascia; *c*, *tibialis anticus*; *d*, *extensor proprius pollicis pedis*; *e*, anterior tibial nerve; A, artery upon Deschamps' needle.

Incision No. 2. *Ligature of the anterior tibial in its upper half.*—*a*, incision in the skin; *b*, deep fascia; *c*, *extensor longus digitorum*; *d*, *tibialis anticus*; *e*, anterior tibial vein; A, artery with the needle beneath it.

Incision No. 3. *Ligature of the dorsalis pedis.*—*a*, incision in the skin; *b*, deep fascia; *c*, *peronæus longus*; *e*, external border of the *solæus*; *d*, *flexor longus pollicis*; A, artery upon the needle.

MODES OF OPERATING.

§ 1. *Ligature of the anterior tibial below its middle.*—1st, in the course of a line representing the direction of the artery, or, along the external border of the *tibialis anticus* muscle, the prominence of which can be generally recognised, make an incision through the integuments about three inches in length; 2d, lay open the deep fascia to the same extent upon a director; 3d, separate with the index finger the two muscles until the artery is recognised lying upon the tibia, in company with its two veins; 4th, separate it from its connections and apply the ligature with a needle.

§ 2. *Ligature of the anterior tibial in its upper half.*—1st, about ten lines to the outer side of the spine of the tibia, and in the course of a line drawn from the external tuberosity at the head of the tibia to the middle of the instep, make an incision through the integuments from three to three and a half inches long; 2d, the inter-muscular space being difficult to recognise, it is better to lay open the deep fascia by a crucial incision; 3d, the intermuscular septum will then be sought

for by the finger in the wound, and will generally be recognised by the diminished resistance which it offers; when found, the muscles are to be forcibly separated down to the interosseous ligament, upon which the artery will be found with the nerve lying in front of it, and a vein on either side; 4th, the artery being isolated, the ligature is to be passed beneath it by means of a needle.

§ 3. *Ligature of the peronæal artery below its middle.*—*Malgaigne's method.* Seek for the external border of the fibula, and about two lines behind it, and parallel with it, make an incision through the integuments from two and a half to three inches in length; 2d, divide the deep fascia to the same extent; 3d, the external border of the *soleus* muscle sometimes lies over the fibula, detach this gently and push it inwards; then, commencing from the external border of the bone, which should be fairly in view, detach from its posterior surface the attachments of the *flexor longus pollicis*, which takes its origin from its lower two thirds; 4th, push this muscle inwards, and at its inner border, near the insertion of the interosseous ligament, the artery will be found lying beneath a layer of the deep fascia derived from the investment of the muscle; having divided this, the artery will be found immediately beneath it.

Fig 1.

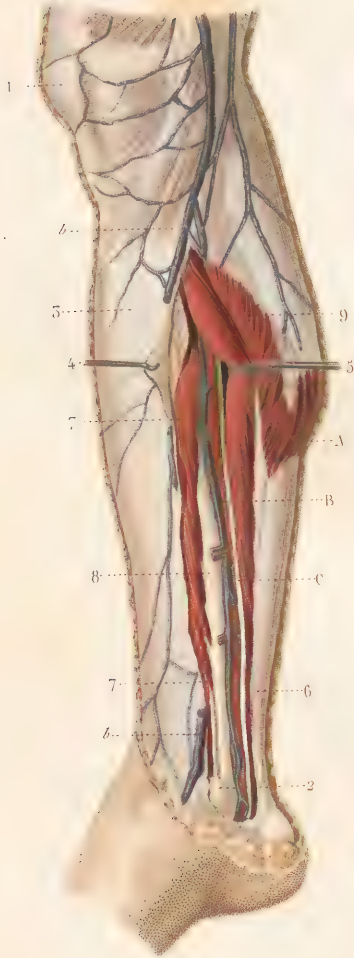


Fig 2.

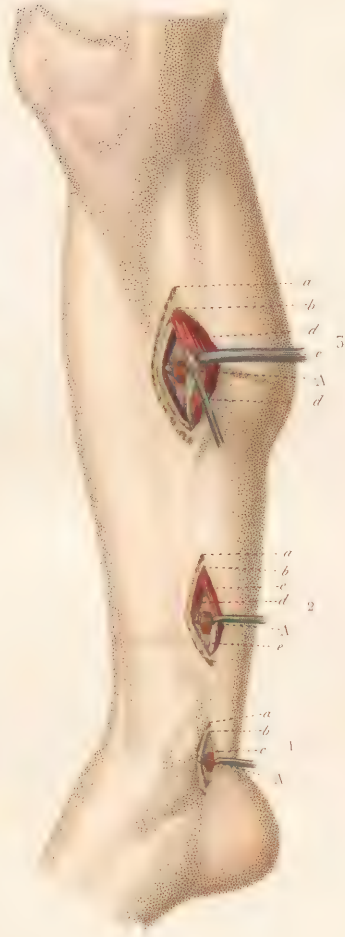


PLATE XIV.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY.

FIG. 1. SURGICAL ANATOMY.

1, patella; 2, internal malleolus; 3, internal surface of the tibia; 4, internal aponeurosis of the limb; 5, *solæus* muscles, pulled backwards by the blunt hook.

A, the *posterior tibial artery*, arises from the popliteal on the inner side, and terminates beneath the internal annular ligament of the tarsus, where it divides into the internal and external plantar arteries. Its direction, somewhat oblique from without inwards, would be represented by an imaginary line drawn from the middle of the popliteal space, and terminating behind the internal malleolus.

In its *upper third*, the *posterior tibial artery* is situated deeply beneath the *tibialis posticus*, 7, and covered also by the deep aponeurosis, 4, the *solæus*, 5, and the *gastrocnemius*, 9; in its *middle third*, it lies nearer the surface, running parallel with the internal border of the tibia, and separated from that bone by the *flexor longus digitorum* muscle, 8, and covered by the deep aponeurosis and the internal border of the *solæus*, 5; finally, in its *lower third*, lying immediately beneath the deep aponeurosis, it runs behind the tendons of the *tibialis posticus* and *flexor longus digitorum*, in relation posteriorly with the inner edge of the tendo Achillis, 6.

BB, the two *venæ comites* of the artery, which anastomose frequently with each other; 6, internal saphœna vein.

C, the *posterior tibial nerve*, lying external to, and behind the artery.

FIG. 2. OPERATIONS.

Incision No. 1. *Ligature of the posterior tibial, in its lower third.*
—a, incision in the skin; b, deep fascia; c, posterior tibial nerve; A, artery on the director.

Incision No. 2. *Ligature of the posterior tibial in its middle third.*
—a, incision in the skin; b, deep fascia; c, external border of the so-

læus ; *d*, flexor longus digitorum ; *e*, posterior tibial nerve ; *A*, artery on the needle.

Incision No. 3. *Ligature of the posterior tibial in its upper third.*—*a*, incision in the skin ; *b*, deep fascia ; *c*, gastrocnemius, carried backwards by a blunt hook ; *d*, incision in the *solæus* muscle ; *A*, artery with the needle beneath it.

MODES OF OPERATING.

§ 1. *Ligature of the posterior tibial artery in its lower third, or behind the malleolus.*—*Velpeau's method.*—About one-third of an inch behind the posterior border of the internal malleolus, make a semicircular incision through the skin only, of an inch and three quarters in length, with its concavity looking towards the malleolus ; 2d, incise the aponeurotic layer beneath cautiously upon a director, carefully avoiding the sheaths of the tendons which lie immediately behind the malleolus ; 3d, beneath the aponeurosis, and in front of the nerve, the artery will be found, between its accompanying veins.

§ 2. *Ligature of the posterior tibial in its middle third.*—1st, At the distance of three-quarters of an inch from the internal border of the tibia, or, in a line midway between the internal border of the tibia and the *tendo Achillis*, make an incision from two and a half to three inches in length through the integuments ; 2d, incise the deep fascia to the same extent, and push the edge of the *solæus* muscle out of the line of incision ; 3d, divide the deep aponeurosis upon the director, when immediately beneath it, the artery will be seen, between its two veins.

§ 3. *Ligature of the posterior tibial artery in its upper third.*—*Malgaigne's method.*—1st, At the distance of two thirds of an inch from the internal border of the tibia make an incision at least four inches in length, through the integuments and deep fascia ; 2d, carrying the index finger into the wound, detach and push outwards the internal head of the *gastrocnemius*, and divide also the attachments of the *solæus*, thus exposed, from the posterior surface of the tibia ; 3d, whilst an assistant keeps this muscle held backwards and outwards with a blunt hook, divide the deep layer of aponeurosis upon a director, and search for the vessel immediately beneath it ; 4th, detach the artery, and pass the ligature beneath it with the artery needle.

Manec's method. Instead of detaching the *solæus* muscle from the tibia, this author directs that it should be divided, throughout its entire thickness, about an inch from the internal border of the tibia ; this

brings in view a thick, pearly, fibrous layer of tissue, into which its fleshy fibres are inserted, the anterior sheath of the muscle, which is perforated by several small arteries. Dividing this freely upon a director, the deep aponeurotic layer covering the artery is brought in view. In the first mode of operating it may happen in the living subject, as in the case of M. Bouchet of Lyons, that in consequence of the contraction of the muscles interfering with the operator, it might become necessary to cut across the *solæus* muscle. The object of Manec's method is to prevent the necessity of this step.*

* Mr. Guthrie proposes to substitute a perpendicular incision, six to seven inches in length, through the centre of the calf, for the ordinary modes of reaching the posterior tibial artery.—*Eds.*

PLATE XV.

LIGATURE OF THE POPLITEAL ARTERY.

FIG. 1, 2, AND 3. SURGICAL ANATOMY.

Fig. 1. *View of the parts after removal of the integuments.* Superficial vessels and nerves.

1, 1. Deep fascia removed in the upper half of the popliteal region ; 2, *semi-membranosus* muscle ; 3, *biceps* ; 4, cutaneous vessels and nerves ; 5, internal saphœna vein.

A, *external, or posterior saphœna vein* ; it runs perpendicularly, following the median line of the limb to the middle of the popliteal space, where it perforates the deep fascia ; beneath the fascia it still ascends, and winds around the popliteal nerve, to empty into the popliteal vein. In the first part of its course, above the deep fascia, it is accompanied on its outer side by the *external saphœnous nerve, b* ; it frequently overlays the nerve, and is separated from it by a process of the deep fascia which forms a separate sheath for the nerve.

C, popliteal nerve, lying immediately beneath the deep fascia, passes down the centre of the popliteal space, being situated superficial to, and a little on the outside of the popliteal vessels, from which it is separated by a thin layer of adipose tissue. It gives off several branches, of which the principal is the *external saphœnous nerve, b*, which, after running a short distance beneath the deep fascia, emerges through the same opening which transmits the external saphœna vein.

D, *the peroneal nerve* ; more superficial and smaller than the preceding, it is given off from it, at an acute angle, in the upper part of the popliteal space, and descends obliquely from within outwards, beneath the deep fascia, to be distributed to the muscles on the outside and front of the limb. In the popliteal space it gives off the *communicans peronei*, which is one of the roots of the external saphœnous nerve, and a branch, *c*, which pierces the deep fascia, and ultimately anastomoses with the external saphœnous nerve.

FIG. 2. *View after removal of the deep fascia.*—The popliteal

nerve being cut away in a part of its course, and the adipose tissue dissected out, the vessels are exposed to view.

A, the *popliteal artery*, extending from the tendinous opening in the *adductor magnus* muscle to the lower border of the popliteus, runs a little obliquely from within outwards, covered in its whole course, and crossed about the middle of the popliteal space, by the *popliteal vein*, B, whose direction is vertical; in consequence of this relation the artery, always beneath the vein, is somewhat internal to it above, and external to it below. The two vessels are covered superiorly by the belly of the *semi-membranosus*, 1; below they pass between the two heads of the *gastrocnemius*, 2, 3. They are connected together, throughout their course, by dense cellular tissue which renders their separation difficult.

FIG. 3. The *popliteal artery*, at first on the inner side of the femur, 1, afterwards approaches the centre of its posterior face, and passes downwards between the condyles, 2, 3, in contact with the articulation, 2. In its course it gives off several branches, of which the principal are: the *superior articular arteries*, a, b, c; the *inferior articulars*, d, e, which anastomose with the preceding in front of the knee; the *middle articular arteries*, which enter the articulation, and the *sural arteries*, f, g, which enter the *gastrocnemius* muscle.

FIG. 4. OPERATION.

Ligature of the popliteal artery in its superior half.—a, incision of the skin; b, deep fascia; c, adipose tissue; d, peroneal nerve; e, external saphoena vein; f, popliteal vein; A, artery upon the needle.

MODE OF OPERATING.

Ordinary method.—1st, the patient lying on his face with the limb extended moderately, make an incision from three to four inches in length through the skin and cellular tissue in the middle of the popliteal space, and in the dissection of the length of the limb; 2d, divide the deep fascia to the same extent upon a director, taking care to push the external saphoena vein to the outside; 3d, tear very carefully through the cellular tissue and fat, with the point of the director, at the same time flexing the leg slightly upon the thigh in order that the muscles may be separated with more facility; 4th, push the popliteal nerve, which is encountered first in the wound, to the inside; beneath this and a little to the inner side is found the popliteal vein, whose

connections are to be cautiously detached and the vein pushed also to the inner side, whilst the artery is sought for beneath it, in contact with the ligaments of the articulation.

The popliteal artery may also be tied, both in the upper and lower half of the popliteal space, by the following method, with this difference only, that in order to reach the artery *in its lower half*, the external incision must be made three and a half inches long, commencing half an inch below the articulation of the knee, and extending along in the centre of the interval between the two heads of the gastrocnemius muscle. To tie the artery *in the upper part of its course* (see fig. 4), above the condyles of the femur, an incision four inches in length is required, which should begin on the lower third of the thigh, at a point opposite to the commencement of the artery, near the external border of the muscular prominence bounding the popliteal space on its inner side, and terminate at the centre of the space, opposite to the articulation.

Marchal's method.—Here the operator proposes to tie the artery in its lower half, but in place of getting at it through the popliteal space, as heretofore, the incision is made on the inner side of the limb just below the internal condyle of the femur. To do this, the patient should be placed upon his back, the limb flexed and lying on its outer side, and the surgeon standing on its outer side; an incision three inches in length is then made obliquely downwards and inwards, hugging the internal edge of the inner head of the gastrocnemius, and four or five lines distant from the inner border of the tibia. The integuments being incised, and the internal saphœna vein kept out of the way, the inner head of the gastrocnemius is separated from the deep layer of muscles by introducing the finger into the wound, and breaking down its cellular adhesions, and at the same time bending the leg upon the thigh to secure relaxation of its muscles; in this manner the artery is soon reached, lying on the inside of the posterior tibial nerve, and surrounded by several veins; nothing more is required but to divide the lamina of deep fascia which lies over it.

Jobert's method.—Here the artery is tied in its upper part, but through the inner side of the thigh, just above the condyle, instead of through the ham. The incision should be three inches long, and should correspond to the *vastus internus*, and the muscles which form the inner border of the popliteal space.

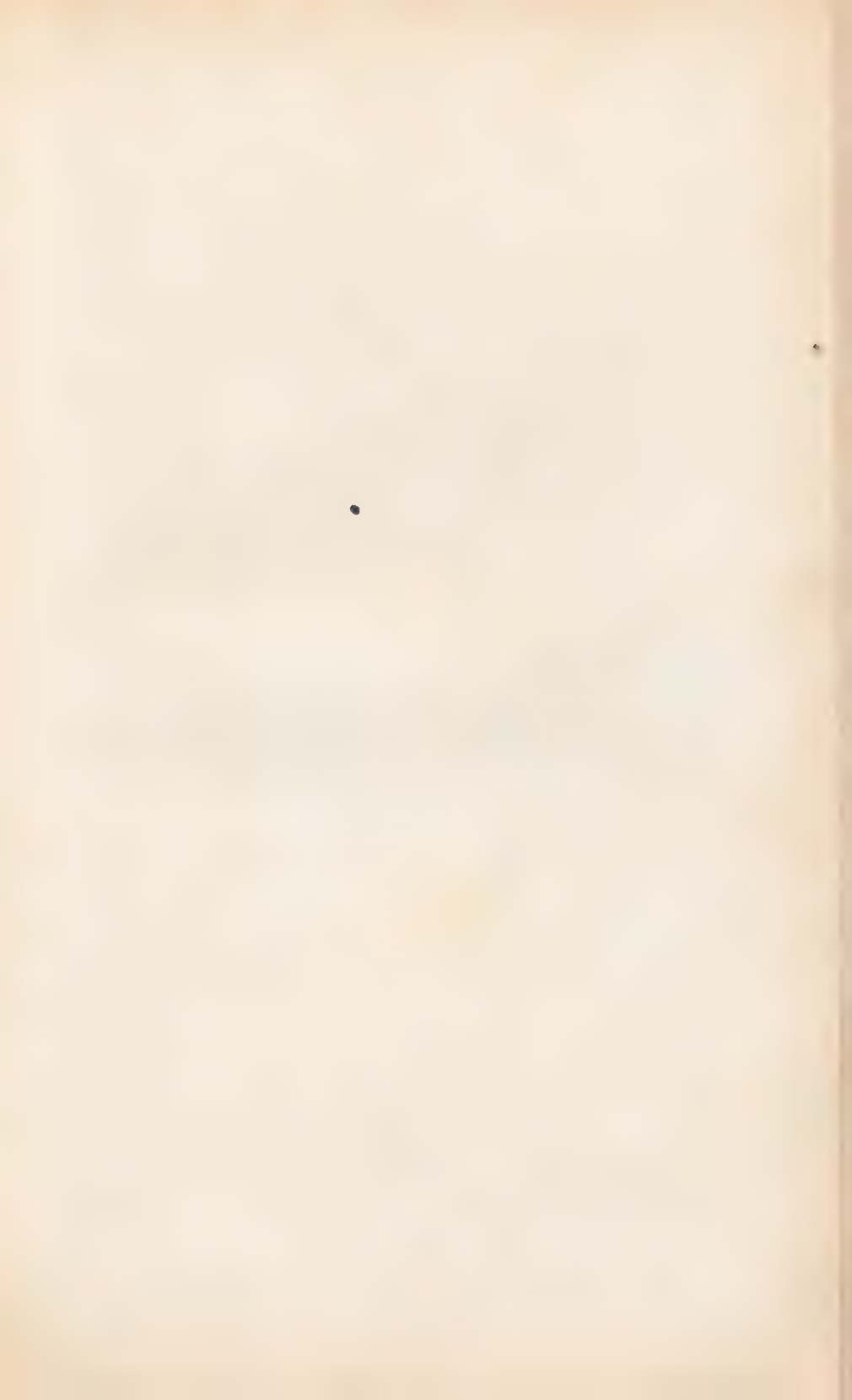


Fig 1.



Fig 2.

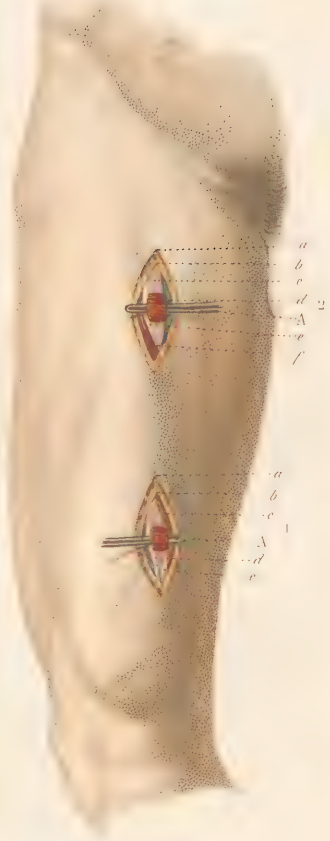


PLATE XVI.

LIGATURE OF THE FEMORAL ARTERY.

FIG. 1. SURGICAL ANATOMY.

A, the *femoral artery*, the continuation of the external iliac, commences beneath the middle of the crural arch, formed by Poupart's ligament, 1, and terminates at the tendinous opening in the *adductor magnus* muscle, where it takes the name of *popliteal*. Its course is oblique, winding around the thigh in a spiral direction; at its commencement it is in front; in the middle of the thigh, on its internal side; and below, in the popliteal space, on its posterior aspect. In its upper fourth the artery is covered only by the lymphatic glands of the groin, the fascia lata, and the skin; here, its superficial position renders it easily compressible against the horizontal ramus of the pubes, or the head of the femur, which lie behind it. Lower down, the *sartorius* muscle lies between it and the integuments, crossing its track very obliquely, in such a manner that the artery corresponds with the internal edge of the muscle at one part of its course, and below, at the opening in the *adductor* muscle, with its external edge.

C, the *femoral vein*, accompanies the artery throughout its course; on its inner side, beneath Poupart's ligament; behind it, in the middle of the thigh; and behind, and a little to its outer side, below. The two vessels, which are connected by an unusually dense cellular tissue in the lower two-thirds of their course, are contained besides in a sheath given off by the fascia lata. The *internal saphœna vein*, d, which lies immediately beneath the skin, skirts along the internal edge of the *sartorius* muscle, and empties into the femoral vein of the saphœnous opening.

Æ, the *arterial crural nerve* lies on the outer side of the artery, and is separated from it by a layer of the iliac fascia.

The *long saphœnous nerve*, F, enters the sheath of the vessels, in their upper fourths, and runs down in company with them from this point, lying on the outer side of the artery; at the opening in the *ad-*

ductor magnus it crosses in front of the artery, and still lower down leaves it to accompany the internal saphœna vein. Another branch of the anterior crural nerve, *g*, lies in front of the femoral sheath, and from this a filament is given off, *h*, which passes across the vessels to join the internal saphœnous vein which it accompanies *i, i*; musculo-cutaneous branches.

FIG. 2. OPERATION.

Incision No. 1. *Ligature of the femoral artery in its lower fourth.*—*a*, incision in the skin and subcutaneous cellular tissue; *b*, fascia lata; *c*, external edge of the *sartorius*, pushed inwards; *d*, long saphœnous nerve; *e*, the tendinous sheath of the femoral vessels; *A*, the artery, on the director.

Incision No. 2. *Ligature of the femoral artery in its upper third.*—*a*, incision through the integuments; *b*, fascia lata; *c*, sheath of the femoral vessels; *d*, femoral vein; *e*, saphœnous nerve; *f*, inner edge of the *sartorius*; *A*, artery upon the director.

MODES OF OPERATING.

§ 1. *Ligature of the femoral artery in its lower fourth, or at the opening in the adductor muscle.* (See fig. 2, incision No. 1.) 1st. The thigh being slightly flexed and rotated outwards, and the course of the artery being represented by a line drawn from the middle of Poupert's ligament downwards, and crossing the thigh obliquely inwards to the centre of the popliteal space, make an incision on this line,—or still better, if it can be recognised beneath the integuments, along the external edge of the *sartorius* muscle,—to the extent of three inches, through the skin and subcutaneous cellular tissue,—the centre of the incision corresponding to the union of the middle with the lower third of the thigh.

2d. Recognise with the finger the position of the *sartorius* muscle, and divide the fascia lata some two lines within its outer border; this will allow the muscle to be pushed inwards, and the posterior layer of its fascial sheath to be divided to the same extent. Then, feeling with the finger for the separation between the *vastus internus* and *adductor* muscles, divide carefully on a director the fibro-cellular layer which lies between them; this is the anterior wall of the canal formed for the passage of the artery, and after its division the vessel is brought in sight, with the vein behind it, and the nerve in front, and to its outer side.

3d. Separate very cautiously the dense cellular tissue by which the vessels are connected, and pass the needle from without inwards.

§ 2. *Ligature of the femoral at the middle of the thigh.*—1st, The limb being placed in the situation already described, make an incision on the course of the artery, at the middle of the thigh, following the internal edge of the sartorius muscle, and taking care not to wound the internal saphœna vein; 2d, push the *sartorius* muscle outwards until the sheath of the vessel, which lies beneath it, is brought into view; 3d, carefully lay open the sheath of the vessels upon a director; 4th, separate the vein from the artery, which is more easily effected at this point, and pass the needle from within outwards (see fig. 2, incision No. 2).

§ 3. *Ligature of the femoral in the upper third of the thigh, or in Scarpa's space.* In this method the object is to get at the artery near the apex of the triangle in which it lies in the upper third of the thigh, which is formed by the meeting of the *sartorius* and the *adductor brevis* muscles, its base being Poupart's ligament.

1st. At about four inches and a half below Poupart's ligament, the point where the artery begins to pass beneath the *sartorius* muscle, and where its pulsations become consequently somewhat less distinct, commence an incision three inches in length and carry it downwards along the internal edge of the *sartorius*. 2d, the *saphœna* vein, which lies in the cellular tissue beneath the skin, must be pushed inwards to avoid its being wounded, and some of the lymphatic vessels and glands are almost of necessity involved in the incision. 3d, the fascia lata being divided on the director, we come at once upon the artery in its sheath, lying along the inner border of the muscle, with the saphœnous nerve on its outer side, and the femoral vein within and behind it. 4th, the artery having been carefully isolated, pass the needle, or director, beneath it from within outwards.

PLATE XVII.

LIGATURE OF THE FEMORAL ARTERY UNDER POUPART'S LIGAMENT, OF THE EXTERNAL ILIAC, AND EPIGASTRIC ARTERIES.

FIG. 1 AND 2. SURGICAL ANATOMY.

Fig. 1, 1. The external oblique, internal oblique and transversalis muscles with the integuments and aponeurotic layers which constitute the anterior wall of the abdomen, removed by dissection, leaving, 2, the peritonæum and fascia transversalis, concealing the convolutions of the intestines. The fascia transversalis furnishes an investment for the spermatic cord in the shape of an infundibuliform prolongation, 3; 5, Poupart's ligament, or crural arch; 6, fascia lata,—its cribriform portion removed to show the femoral vessels.

A, *femoral artery*; B, femoral vein; between the vein and artery a layer of fascia is seen, 7, which is the partition by which the femoral canal is divided into separate compartments. C, D, internal saphœna vein, with lymphatic vessels and glands.

A', the epigastric artery, arising from the inner side of the external iliac, beneath Poupart's ligament. It passes beneath the spermatic cord, (beneath the round ligament in the female,) making a curve the concavity of which looks upward, and passes up obliquely from without inwards, between the peritonæum and fascia transversalis to the external edge of the rectus muscle, beneath which it is lost. 8, the two veins which accompany the artery.

Fig. 2. 1, section of the muscles of the abdomen at their insertion into the crest of the ilium; 2, anterior superior spine of the ilium; 3, fascia lata of the thigh; 4, psoas muscle; 5, iliacus internus muscle.

A, *aorta*; B, *right primitive iliac*; arising from the aorta at its bifurcation, opposite to the inferior border of the fourth lumbar vertebra, it descends obliquely outwards to the sacro-iliac symphysis, where it divides into the *external iliac artery*, C, and the *internal iliac*, D.

The *external iliac* C, continues in the direction assumed by the primitive iliac until it arrives beneath Poupart's ligament, so that the

Fig 1

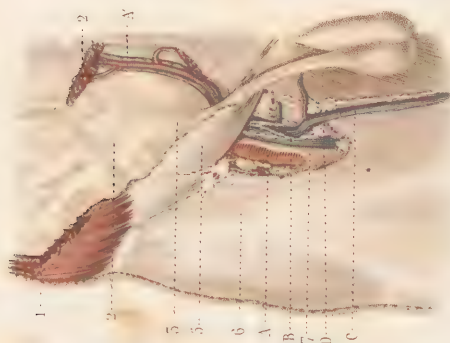


Fig 2.

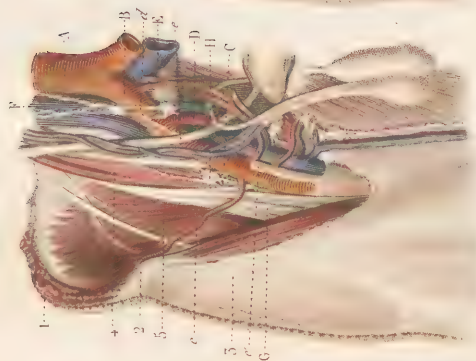


Fig 3



two arteries together form almost a straight line, resting above upon the vertebral column, and lower down upon the psoas muscle, 4; the external iliac artery, whilst passing beneath Poupart's ligament, gives origin on its outer side to the circumflex iliac artery, *c*, and within, to the epigastric, *c'*.

The internal iliac, or hypogastric artery, D, diverges from the preceding at an acute angle, and passing downwards into the pelvis is distributed to the organs contained in that cavity.

At their point of origin at the sacro-iliac symphysis, the *iliac arteries* are crossed by the *ureter*, *e*, and the *spermatic vessels*, *d*.

E, the *iliac veins*, situated at first on the inner side and behind the arteries, unite to the right of the bifurcation of the aorta to form the *inferior vena cava*, F.

The left iliac vein, at first in contact with its artery, towards its termination crosses behind the right iliac artery, in order to form a union with its fellow of the opposite side.

G, *anterior crural nerve*. H, H, *lymphatic vessels and glands*.

FIG. 3. OPERATION.

a, incision in the skin; B, C, D, divided edges of the muscles and fascia of the anterior abdominal walls; *e*, peritonæum detached and pushed upwards; *f*, external iliac vein; A, external iliac artery, with the needle beneath it.

MODES OF OPERATING.

§ 1. *Ligature of the femoral artery beneath Poupart's ligament*.—1st, beneath the centre of a straight line drawn from the anterior superior spine of the ilium to the symphysis pubis the pulsations of the femoral artery can be readily felt, as it is here very superficial. 2d, make an incision commencing immediately over Poupart's ligament, and extending two inches downwards in the course of the vessel; this incision will involve the skin, subcutaneous cellular tissue, and some lymphatic vessels and glands which it is impossible to avoid. 3d, divide with care, upon the director, the sheath of the vessels, beneath which the artery will be found, with the nerve on its outer side and the vein within, but separated from each by a process of fascia, (see fig. 1-7). 4th, separate the artery from its connections, and pass the needle from within outwards.

§ 2. *Ligature of the external iliac artery*.—The patient lying upon his back with the muscles of the abdomen in a state of relaxation, make

an incision three and a half inches in length, just above Poupart's ligament, and parallel with its general direction, but in a curved line, with the convexity downwards. The first stroke of the knife through the skin and superficial fascia divides sometimes the superficial epigastric artery, the cut ends of which should be tied before proceeding farther. The aponeurotic expansion of the external oblique should then be carefully divided, and afterwards the internal oblique and transversalis to the same extent. The finger should now be carried along the spermatic cord into the internal ring, and the fascia transversalis pushed upwards and outwards, taking great care not to injure the peritonæum. If at this stage of the operation the artery cannot be recognised by the eye at the bottom of the wound, the finger should be employed to ascertain its exact position, and then, with the point of the director, the sheath of the vessels furnished by the *fascia iliaca* should be cautiously torn through, and by the same means the artery should be separated from the vein and the nervous filament which accompanies them, and the needle inserted beneath it from within outwards.*

§ 3. *Ligature of the epigastric artery.*—The incisions employed in the ligature of the preceding artery may be applied to the epigastric, only they should not be so extensive. When the spermatic cord is brought in view, let it be lifted up so as to expose the inner border of the internal ring, through which it is about entering the cavity of the abdomen. Dilate the ring by introducing the point of the finger, and immediately behind the layer of transversalis fascia, which constitutes its internal border, the pulsations of the artery will be felt.

§ 4. *Ligature of the internal iliac artery.*—*Stevens' method.*—1st. Make an incision from four and a half to five inches in length, half an inch on the outer side of the epigastric artery and parallel with it. 2d. Having divided successively the integuments and abdominal muscles, detach the peritonæum with the utmost care from the psoas and iliacus muscles, and push it gently inwards and upwards until the bifurcation of the primitive iliac can be distinguished. 3d. Feel for, and isolate the artery with the index finger, and pass the ligature beneath it.

A similar process may be employed for the ligature of the *primitive iliac artery*.†

* This operation was first performed by Abernethy, in 1796.

† The *primitive iliac artery* may be tied by means of an incision similar to that employed for the ligature of the external iliac, but carried upwards and outwards to the extent of from five to seven inches. The external iliac being recognised as

§ 5. *Ligature of the gluteal artery. Robert's method.*—The patient lying upon his face, ascertain in the first place the position of the top of the great trochanter and the posterior superior spine of the ilium. 2d. Make an incision three inches in length, commencing an inch below the posterior superior spine of the ilium, and an inch to the outer side of the sacrum, and descending obliquely towards the top of the great trochanter. 3d. The incision having been carried successively through the skin, cellular tissue, and the fibres of the *glutæus magnus* muscle, the artery will be found lying immediately below the upper edge of the great sciatic notch. 4th. Separate the *pyramidalis* and *glutæus medius* muscles, which tend somewhat to conceal the artery, isolate it, and pass the ligature.

above, it is followed upwards, the peritonæum being very cautiously detached and raised in the same direction until the common iliac trunk is brought in view. The ligature is then passed beneath it, with the aid of the American artery needle, from within outwards, carefully avoiding the ureter.

This operation was first successfully executed in this manner by Mott, in 1827. It has been performed in all, fourteen times, at least six of which were successful. —Eds.

AMPUTATIONS

THROUGH THE JOINTS, OR DISARTICULATIONS.

When it becomes necessary, from one of the various causes, which it is not required to enumerate in this place, to remove a limb, or a part of a limb, by amputation through one of its joints, it is requisite: 1st, to recognize accurately the situation of the articular surfaces; 2d, to divide the parts which unite them by cutting across the articulation; 3d, to manage the incisions through the soft parts surrounding the articulation in such a manner that enough of them shall be left to cover the stump fairly, in order that cicatrization may take place without difficulty.

§ 1. *General rules for determining the position of a joint.*—Around the extremities of almost all the bones which articulate with other portions of the skeleton certain bony prominences, or *tuberosities*, are distinguishable beneath the skin. These tuberosities, situated at variable distances from the joint, always bear to it accurate and unvarying relations, and are therefore sure guides to the surgeon. To recognize them with facility, the following mode of examination should be adopted: 1st. Commence always with that which is the most prominent and well marked, and having recognized its exact position and relations, the other smaller and less distinct projections will be more readily made out. 2d. To do this to the best advantage, place the limb to be examined in a convenient position, and from time to time, as required, give the joint all its natural motions in succession, and thus the bony prominences around it will be rendered more evident, and the tendons, or ligaments, attached to them, will be thrown more or less into relief.

We generally find also around the articulations *wrinkles*, or *creases in the skin*, the position of which is sufficiently constant to serve as indications to the surgeon of the situation of the joint. These folds in the skin, which are particularly well marked around the joints of the fingers, are sometimes found lying immediately over the articulation, at others again at a constant distance from it.

It might happen, however, that an accumulation of fat, or serum, around a joint, should mask the bony prominences, and efface the

wrinkles in the skin; or that a painful disease in its vicinity should render it impossible to give the joint its natural motions. In such a case we should endeavor to recognize the parts, as far as possible, by searching along the shaft of the bone towards its extremity with the finger, and then, if absolutely necessary, cut in the probable situation of the joint, making an appropriate flap, and feel in the wound for its exact position; failing in this search, the heel of the knife, applied perpendicularly to the bone, should be carried up and down its surface, in the probable situation of the joint, until its edge enters between the articular surfaces.

§ 2. *Rules for cutting through an articulation.* To traverse an articulation without hesitation, in the midst of the blood and soft parts which frequently mask the articular surfaces, the operator should have the disposition of the joint so fixed in his mind, that he could trace it out exactly without having it under his eye. It is no less necessary that he should be familiar with the exact situation, size and attachments of its ligaments, in order to recognize and cut through them without delay.

According to Lisfranc, knives for disarticulations should be narrow in the blade, in order that they may be readily turned in a joint, and thick in the back to ensure sufficient strength.

These points settled, we proceed to the operation of disarticulation, keeping in mind the following general rules:

1st. The thumb and index finger of the left hand should be applied one on either side of the joint, for the purpose of defining its exact position, when ascertained, and of guiding the knife accurately.

2d. When an articulation is to be entered from its anterior aspect, it should be held in the extended position; when on the contrary, the knife is applied to its posterior surface, the limb should be semi-flexed, in order to increase the distance between the articular surfaces.

3d. The principal ligaments of the joint should be divided at first. The lateral and dorsal ligaments being severed, the knife can generally be carried between the articular surfaces. But if the joint present several irregular surfaces for articulation, what are denominated *interosseous ligaments* may exist, passing from one bone to the other, within the joint; these require to be divided with the point of the knife before it can be fairly entered.

4th. When the articulation has been thus opened, it is in general sufficient to make gentle traction on the distal portion of the limb, in

the direction of its axis, in order to separate the articular surfaces enough to allow the knife to be passed between them. If the joint is too close and tight for this manœuvre to succeed, the articular surfaces must be partially dislocated, always, however, employing great care that no violence be done to the neighboring soft parts. Finally, if any ligaments should prove to be ossified, they must be divided by the saw.

5th. When the knife has fairly entered the articulation, its heel and point should act in the same plane, and if, whilst it is being carried around the articular surfaces to the opposite side of the limb, the integuments from which the flap is to be formed should be in danger of being cut irregularly, they should be drawn out of the way by the thumb and index finger of the hand which supports the articulation.

§ 3. *Of the mode of operating.*—The manner of making the incisions in the soft parts to provide a covering for the stump, depends upon the kind of operation selected. For all amputations of the limbs there are three principal forms given to the wound. In the first, the soft parts are all divided by a *circular* incision around the limb, and the cut surface is afterwards covered by the integuments only, which, before the section of the muscles, are turned up like the cuff of a sleeve. In the second, the part to be removed is circumscribed by an elliptic incision, which, after the operation is finished, leaves a wound, the edges of which are easily brought in contact, and whose shape gives the name to this style of amputation of the *oval* method. Finally, in the third mode, one or more flaps are fashioned out of the soft parts in its vicinity for the purpose of covering the extremity of the amputated limb; and to this process the name of *flap* operation is applied. To each of these general methods belongs a variety of operative procedures; all of which result, however, in the production of a stump bearing the characteristics either of the *circular*, *oval*, or *flap* operation. Thus, then, the general method indicates the character of the result aimed at, and the modes of operating, the different means by which this result is attained.

§ 4. *On the formation of flaps.*—1st. One, or several flaps may be made, according to circumstances. In the latter case, the least important flap should be made first, and that containing the larger vessels should be left until after the separation of the bones is completed, in order that, if necessary, they may be seized and compressed by an assistant before their final section.

2d. The flap should terminate by a curved line, and not by a point,

and to effect this, the knife must be carried along freely and without hesitation, parallel with the bone, until, by bringing it in contact with the surface it is intended to cover, it is found to be of sufficient length, when turning the edge of the knife directly outwards, the tissues are cut through square and clear. If the tendons project beyond the skin, they should be cut off with the scissors.

3d. Healthy tissues should be selected as much as possible for the formation of flaps; nevertheless, if necessary, they may be made from inflamed or infiltrated parts, as by judicious management this swelling will diminish under the suppurative process without much danger of gangrene. Finally, according to Lisfranc, a disarticulation may be undertaken where there are no soft parts from which to form a stump, experience having proved that a sound cicatrix will be formed over the articular surfaces.

PLATE XVIII.

DISARTICULATION OF THE LAST TWO PHALANGES OF THE FINGERS, AND OF THE WHOLE FINGER.

SURGICAL ANATOMY.

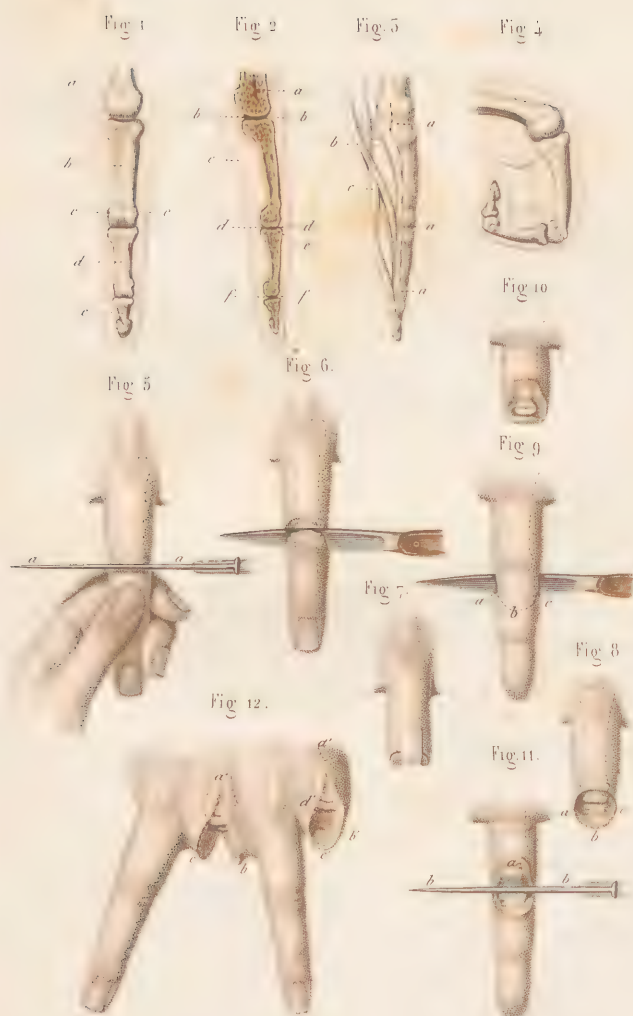
Fig. 1. *Bones of a finger in their natural relation, seen on their palmar aspect.*—*a*, inferior extremity of the metacarpal bone; *b*, first phalanx; *c*, head of the first phalanx; *d*, second phalanx; *e*, third phalanx.

The phalangeal articulations are all perfect ginglymoid joints, that is to say, they allow but of two motions, flexion and extension. The head of the first phalanx presents two condyles separated by a groove; these fit into the two corresponding cavities in the second phalanx, which have a ridge between them. Each phalanx presents, also, near its articular surfaces, decided bony projections, both on its palmar and dorsal aspect, (Fig. 1, *c, c*; fig. 2, *e*.); two lateral ligaments give the articulations almost all their firmness. The extensor tendon behind, and a ligament in front, of little strength, complete the ligamentous apparatus of each joint. The interarticular line, the direction of which is almost transverse, of the articulation of the first with the second phalanx, is exactly opposite the fold of the skin on its palmar surface, and in the articulation of the second with the third, it is a line and a half below its corresponding fold.

Fig. 2. *Vertical section of the bones of a finger, showing the relations which the lines of the articulations bear to the folds of the skin.*—*a*, inferior extremity of the metacarpal bone; *bb*, line of the metacarpophalangeal point, to be found, in the normal state, about twelve or thirteen lines above the commissure of the fingers, *c*; *dd*, inter-articular line between the first and second phalanges, situated exactly opposite the fold of the skin; *ff*, inter-articular line between the second and third phalanges, situated a line and a half below the fold of skin on the palmar surface of the finger.

Fig. 3. *Relation of the flexor tendons to the bones of the finger.*—

PL. 18.



a, a, a, dorsal aspect of the articulations ; *b*, tendon of the *flexor digitorum sublimis perforatus* ; *c*, tendon of the *flexor profundus perforans*.

Fig. 4. *View of a finger in a state of flexion, showing the relation of the articular surfaces of the phalanges to each other when flexed.*

OPERATIONS.

Fig. 5. *Disarticulation of the second phalanx (finger) ; from the dorsal aspect of the joint. 1st, Lisfranc's method.*—1st, the edge of the bistoury *a, a*, about to enter the articulation.

Fig. 6. Same operation. 2d, after having cut through the articulation, the bistoury is brought beneath the second phalanx, for the purpose of cutting out a flap from its palmar surface.

Fig. 7. Operation finished ; flap brought up into its place, and retained there by a strip of adhesive plaster.

Fig. 8. A modification of the preceding method. (*See modes of operating*).

Fig. 9. *Disarticulation of the second phalanx ; from the palmar aspect of the joint. Lisfranc's second method.*—*a, b, c*, shape to be given to the palmar flap.

Fig. 10. Operation completed.

Fig. 11. Same operation after the bistoury *b b* has entered the joint, the flap being turned upwards.

Fig. 12. *Disarticulation of the entire finger.*—*a, b, c*, wound left after the operation with two flaps ; *a' b' c' d'*, wound left after the operation by the oval method.

MODES OF OPERATING.

§ 1. *Amputation of the finger between the first and second phalanges. Circular method.*—The hand being placed in the state of pronation, an assistant should confine all the fingers in a flexed position except the one about to be operated on. Then the operator, holding the finger in an extended position with the thumb, index and middle finger of his left hand, makes a circular incision around it with the bistoury held in the first position, one-third of an inch below the articulation for the second phalanx, and one-fourth of an inch for the last phalanx. This incision being carried through the skin and cellular tissue, the assistant, by a suitable amount of traction, drags up the in-

teguments as far as the articulation, so that the surgeon can cut through it by dividing its ligaments, entering his knife on its dorsal aspect.

Flap Operations.—Ledran's method by two lateral flaps, and Garangeot's operation, with a dorsal and a palmar flap, are at present out of use, the operation with a single flap having been almost entirely substituted for them.

Lisfranc's first method, or disarticulation from the dorsal aspect of the joint.—An assistant supports the hand well pronated, and confines the sound fingers, keeping them as far as possible out of the way of the operator. The surgeon then takes the phalanx to be removed between the thumb and index finger of his left hand, (fig. 5,) and bends it to an angle of 45° ; then, with a straight bistoury held in the first position, (pl. 1, fig. 1,) he enters the articulation on its dorsal aspect, cutting perpendicularly, a line and a half from the top of the inclined plane formed by the semi-flexed phalanx, or on a level with the fold in the skin on the palmar aspect of the joint for the second phalanx, and a line and a half below the corresponding fold for the first phalanx. At the same time that it penetrates the joint, the bistoury, carried from heel to point, should form a little semi-circular flap on its right and left sides, and the lateral ligaments should be divided as the blade enters between the articular surfaces, (fig. 6.) The phalanx should now be grasped by its sides, and the knife carried around its head to its palmar surface, along which it should be carried towards the operator, to a distance of four lines, in order to make a semi-circular flap of suitable size to cover the stump.

Fig. 7. In cutting the lateral ligaments of the articulation, care must be taken not to nick the base of the flap. The condyles of the first phalanx sometimes project on either side through the wound. To obviate this, the dorsal incision should be made as much of a curve as possible, with its concavity locking downwards, especially towards its lateral extremities.

Fig. 8. *Lisfranc's second method, or disarticulation from the palmar aspect of the joint.*—The hand is to be held in the position of forced supination by an assistant, who confines all the fingers in a flexed position, except the one about to be operated upon. The surgeon grasps the phalanx to be removed with the thumb and finger of his left hand, and in order to avoid wounding himself with the point of the bistoury, he should grasp it in such a manner that his thumb is applied upon the palmar surface of the phalanx at its distal end, and

the second phalanx of his index finger should cross its dorsal surface at right angles. The operator, then, holding a sharp-pointed bistoury in his right hand, in the first position, (pl. 1, fig. 2), with its blade flat-wise, and its edge towards him, enters its point a line and a half below the fold of skin opposite the joint for the third phalanx, and exactly in a line with it for the second phalanx. It is then carried through the finger directly from one side to the other, in front of the articulation, and in contact with the bone, so as to take up as much upon the blade as possible, (fig. 9.) In this manner, the blade is introduced up to its heel, and then, by alternate motions, its edge being kept close to the bone, it is carried down along its palmar surface to a distance of half an inch, and then made to cut its way out, forming in this manner a semi-circular flap, which is immediately carried upwards by the assistant. The edge of the bistoury is then applied perpendicularly to the joint and carried directly through it, dividing its ligaments and the integuments on the opposite side of the joint without making any posterior flap. Nevertheless, if it is feared that the posterior integuments should retract to too great an extent, their section can be effected a line or two below the articulation.

After the description of these two modes of operating, it can readily be understood, without any further details, how, in varying cases, arising from injuries or otherwise, *two flaps of the same size* could be made, one from the dorsal and the other from the palmar aspect of the finger; or, *a dorsal flap*, somewhat shorter than the palmar one; or, even *lateral flaps* of varying proportions. The rules already laid down for the disarticulation of the phalanges of the fingers are also applicable to the removal of the second phalanx of the thumb, which corresponds with the third phalanx of a finger—(Lisfranc.)

§ 2. *Disarticulation of an entire finger*, (fig. 12.) *Method by double flaps.* *Lisfranc's mode of operating.*—The hand being held in a state of pronation, and the fingers, except the one about to be operated upon, confined on either side by an assistant, the surgeon, before commencing the operation, should endeavor to recognize as accurately as possible the situation of the metacarpo-phalangeal articulation. To do this, it is to be borne in mind that the joint usually lies about an inch above the commissure between the fingers. Another method recommended by Malgaigne, and to which the operator can have recourse, especially when the parts are deformed by injury or otherwise, consists in applying strong traction to the finger whilst the metacarpus is held

firmly, by which means the articular surfaces are drawn apart one or two lines, and a depression, manifest to both sight and touch, is the result of the separation, indicating with exactness the situation of the joint. This being ascertained, the operation is to be effected in the following manner :—

1st. The first phalanx of the finger to be removed, is to be grasped by its dorsal and palmar surfaces, and flexed to an angle of 45° . With a straight bistoury, having a prominent heel to its blade, the surgeon commences an incision over the articulation above the head of the metacarpal bone, starting from the union of the internal two-thirds of the interarticular line with its external third, if he is operating upon the left hand, and *vice versa* for the right hand, and carrying it down to the end of the commissure between the fingers. This incision, made by drawing the bistoury towards himself, and from heel to point, should divide at once all the soft parts down to the bone. Having attained the end of the web between the fingers, the blade of the bistoury should be brought to a perpendicular position, lying flatwise against the side of the phalanx, and then, at the same time that the hand of the patient is elevated so that the operator's eye shall precede the edge of the bistoury, he depresses its handle towards the palm of the patient's hand, whilst the heel of the knife is making an oblique incision on the palmar aspect of the joint similar to that on its dorsal surface.

2d. By the process just described, a lateral semi-circular flap has been circumscribed, which is to be detached from the phalanx. Then the bistoury, still held in the first position, is carried to the bottom of the wound, its blade lying flatwise against the phalanx, and by a gently sawing motion, upwards towards the articulation, until an obstacle is encountered which arrests its progress. This is the head of the phalanx; the blade of the bistoury must be carefully carried around it without allowing it to slip or move irregularly, and as soon as it arrives at the articulation, the diminished resistance will allow it to enter with facility.

3d. The joint is to be cut through with the narrowest portion of the blade of the bistoury, that nearest its point, and in order to effect this part of the operation more readily, the surgeon should make traction upon the fingers, so as to separate the articular surfaces, at the same time that the integuments of the opposite side of the joint are kept out of the way of the edges of the bistoury. The knife having traversed the articulation, it is brought back hugging the opposite side of the

head of the phalanx, and a second semi-circular flap is made like the first, as it cuts its way out through the commissure.

When the double flap amputation is made use of for the index or little fingers, there is but one flap, of course, made from the commissure of the fingers; the other flap, taken from the outer or inner border of the hand, has generally more tendency to contraction, and hence, should be made somewhat larger on this account.

Oval method. Scoutetten's operation.—The surgeon, having grasped the finger as in the preceding description, commences, with the heel of the bistoury held in his right hand, an incision, which, commencing on its dorsal aspect, and a quarter of an inch beyond the articulation, is carried down to the end of the commissure, and thence across the base of the finger on its palmar surface, following exactly in the fold of the skin which lies between the finger and the hand. To facilitate the incision on its palmar surface, the surgeon should carry the finger back into a state of forced extension, but as soon as the knife reaches the commissure on the opposite side, he should flex it again, and resume the same form of incision with which he commenced, carrying it back to join the first near its origin. Each border of the wound should then be detached from the head of the phalanx, and the joint entered from its dorsal aspect, dividing first the extensor tendon, and then the lateral ligaments. By increasing the flexion slightly, and an effort as if to luxate the joint, the division of the flexor tendons is facilitated, and the remaining soft parts being detached, the amputation is finished.

The *circular method* is hardly used at present for the disarticulation of the fingers.

PLATE XIX.

DISARTICULATION OF THE FOUR FINGERS; OF THE METACARPAL BONES.

OPERATIONS.

FIG. 1. *Disarticulation of the four fingers at once.* *a, b, c*, incision over the metacarpo-phalangeal articulations from their dorsal aspect; the knife is about passing beneath the phalanges to cut out a palmar flap.

FIG. 2. Wound resulting from the operation. *a, b, c*, form of the palmar flap.

FIG. 3. *Disarticulation of the first metacarpal bone*, by a modification of the oval method; *a, b, c*, outline of the external incision.

FIG. 4. The thumb is carried across the hand, and the knife about completing the disarticulation of the head *a*, of its metacarpal bone.

FIG. 5. Edges of the wound brought together, shewing the appearance of the cicatrix when healed.

FIG. 6. *Disarticulation of the metacarpal bone of the little finger*, by a variety of the oval method; *a, b, c*, outline and extent of the external incision.

FIG. 7. The preceding operation completed; shape of the cicatrix.

MODES OF OPERATING.

§ 1. *Disarticulation of the four fingers together.*—*Operation with one flap.*—*Lisfranc's method* (fig. 1). The hand being pronated, the surgeon grasps the four fingers in the palm of his left hand, whilst his thumb, placed on the dorsal aspect of the fingers, flexes them moderately. An assistant supports the hand, and retracts the skin as much as possible. Then, with a straight narrow knife, the operator makes a curved incision with its convexity looking downwards, from six to eight lines below the heads of the metacarpal bones, from the index towards the little finger if he is operating on the left hand, and in the opposite direction for the right. The extensor tendons being exposed by the retraction of the integuments, which the operator assists by a



few strokes of the knife, each of the metacarpo-phalangeal articulations is then successively opened, the extensor tendon being first divided, then the lateral, and finally the palmar ligamentous attachments. It remains to carry the knife through the articulations to the palmar aspect of the phalanges, and cut out a flap, which is limited anteriorly by the folds in the skin at the base of the fingers on their palmar surface.

§ 2. *Disarticulation of the metacarpal bone of the thumb.*—*Oval operation.*—*Scoutetten's method modified by Malgaigne* (fig. 3, 4, 5). The hand being held in a position between supination and pronation, make an incision along the dorsal surface of the metacarpal bone of the thumb, commencing six lines above its articulation with the trapezium, and extending through all the tissues down to the bone, to the inner side of the head of the first phalanx of the thumb, on a level with the commissure between the thumb and index finger. Then, carrying the hand into a state of pronation, continue the incision around the palmar surface of the phalanx to its outside, and thence to the dorsum of the metacarpal bone, to meet the first incision about at its middle (fig. 3). Detach the muscles and integuments from either side of the bone, and open the articulation from its dorsal aspect; then, endeavoring to dislocate the bone outwards, complete the division of its remaining attachments.

§ 3. *Disarticulation of the metacarpal bone of the little finger.*—*Oval method.*—*Scoutetten's operation modified by Malgaigne* (fig. 6, 7). The hand being held in a state of forced pronation, commence an incision six lines above the carpo-metacarpal joint, which should be carried down in a straight line to the inner border of the first phalanx of the little finger, until it meets the depression at the base of the finger on its palmar surface, and brought around the base of the finger, following this depression exactly. Then the operator, lifting up the little finger, continues the incision around to its inside, and upwards to join its first portion about opposite to the centre of the metacarpal bone. The integuments and muscles are then detached from the bone, and its articular connections divided with the point of the bistoury in the manner already described.

PLATE XX.

AMPUTATION THROUGH THE CARPO-METACARPAL, AND RADIO-CARPAL ARTICULATIONS.

SURGICAL ANATOMY.

FIG. 1. *a*, inferior extremity of the ulna; *b*, that of the radius; *c*, *d*, *e*, *f*, *g*, *h*, *i*, bones of the carpus; 1, 2, 3, 4, 5, first, second, third, fourth and fifth, metacarpal bones.

The *carpo-metacarpal articulation* is represented by an irregular line, the two extremities of which are easily recognised. *Externally*, it corresponds with the upper extremity of the first metacarpal bone; this can be made to start out from its articulation with the trapezium *i*, to which it is connected by rather lax ligamentous attachments, by carrying the thumb across the palm in a state of forced adduction. *Internally*, the carpo-metacarpal joint is marked by the articulation of the fifth metacarpal with the unciform bone, *f*. The long projection at the upper end of the fifth metacarpal serves as a guide to this point, and it can be readily recognised by carrying the finger along the bone from before backwards; the joint lies a line or so above it. The hook-like process of the unciform bone might also be of some assistance as a landmark; the articulation lies immediately below it.

The *radio-carpal articulation* is formed by the inferior extremities of the radius and ulna, which being slightly concave receive the convexity formed by the scaphoid *d*, the semi-lunar *c*, and the unciform, *e*. The pisiform bone, situated farther in front and below the line of the articulation, forms a projection on the front of the wrist over which the knife passes necessarily in cutting out the palmar flap. The two styloid processes, that of the radius externally, and of the ulna internally, mark the situation of the joint with accuracy. The styloid process of the radius projects downwards two lines farther than that of the ulna; and the articulation lies about two lines and a half above a line passing through the extremities of the two processes. The second fold in the skin on the palmar surface of the wrist, reckoning from the palm, lies immediately over the articulation, and would also answer as a guide to it in case the position of the styloid processes could not be distinguished.

Fig. 1



Fig. 3.



Fig. 2

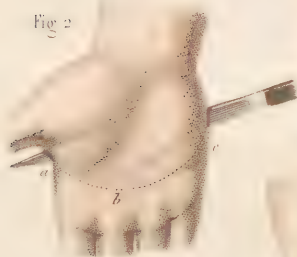


Fig. 6.



Fig. 4



Fig. 5



OPERATIONS.

FIG. 2. *Disarticulation of all the metacarpal bones, preserving that of the thumb. Maingault's operation.* *a, b, c*, form of the palmar flap.

FIG. 3. Same operation. *a, b, c*, incision in the integuments on the back of the hand ; the joint is about being opened.

FIG. 4. *Amputation through the wrist-joint. Circular operation.* *a, b*, fold of integuments turned up like the cuff of a sleeve ; *c c*, knife dividing circularly the tendinous tissues around the joint.

FIG. 5. *Denonvilliers' method.* Flap operation. *a, b, c*, semi-circular incision on the back of the wrist. The knife is cutting out the palmar flap.

FIG. 6. Stump, showing shape of wound. *a, b, c*, palmar flap.

MODES OF OPERATING.

§ 1. *Disarticulation of the four metacarpal bones of the fingers. Operation with a single flap. Maingault's method.* (fig. 2 and 3.)

1st. The hand being held in the position of forced supination, recognise at its outer border the articulation of the first metacarpal bone with the trapezium, and, at its internal side, the articulation of the unciform bone with the fifth metacarpal. 2nd. Introduce a small, straight knife between the bones and the soft parts, carrying it a little below the projections formed by the unciform and the trapezium, so as to bring out its point below the thumb. 3d. Carry the blade of the knife along the anterior surfaces of the metacarpal bones, and cut out a large flap of an elliptical outline. 4th. Then turn the hand in the prone position, and make a semi-circular incision across its back, two thirds of an inch below the line of the articulations, and carrying the knife through the tissues connecting the thumb with the index finger, join the first incision. Whilst an assistant is drawing the integuments upwards, the surgeon, holding the metacarpus in his left hand, proceeds with the disarticulation from the front of the hand, commencing with the metacarpal bone of the index or the little finger, according as he is operating upon the right or left hand.

§ 2. *Amputation through the wrist-joint. 1st. Circular operation. Ordinary method.* (fig. 4.) 1st. One assistant forcibly retracts the skin of the forearm, whilst a second holds the hand to be removed. 2d. The surgeon, holding the knife in his right hand, makes

a circular incision through the integuments, just grazing the thenar and hypothenar eminences at the root of the palm. 3d. He then dissects up the skin as far as the line of the articulation, and reflects it upwards, like the cuff of a coat sleeve. 4th. Second circular incision is then carried through the tendons, and the joint is cut through from its dorsal towards its palmar aspect.

2d. *Operation with a single flap. Denonvilliers' method.*—The hand being held conveniently in a state of pronation, and the integument strongly retracted by an assistant, the operator satisfies himself of the position of the styloid processes of the radius and ulna, grasps them with the thumb and index finger of his left hand, and makes a semi-circular incision with its concavity looking downwards across the back of the wrist, its two extremities falling a little below the styloid projections of the two bones. After this first incision through the skin and cellular tissue, the retraction of the integuments upwards and downwards leaves the wrist joint entirely exposed. A second incision then, in the same direction as the first, across the articulation, divides the extensor tendons and the posterior radio-carpal ligaments. The lateral ligaments are now cut through, and the knife carried through the joint in front of the carpal bones in order to cut out an anterior or palmar flap, which should be at least two-thirds of an inch in length. In order to complete this flap without difficulty, the edge of the knife should be turned sufficiently away from the bones of the carpus so as not to be arrested by their projections, and especial care should be taken that the pisiform bone is not cut away with the flap. After disarticulation by the process just described, there is no danger of the protrusion of the styloid apophyses through the angles of the wound; if the tendons are too long, they may be cut shorter before the wound is dressed.

Fig. 5.

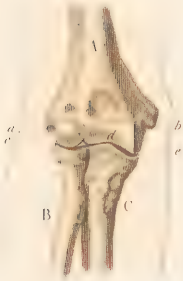


Fig. 1.



Fig. 2.



Fig. 4.



Fig. 5.

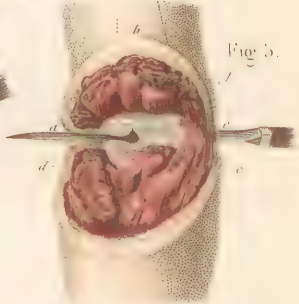


Fig. 7.



Fig. 6.



PLATE XXI.

AMPUTATION AT THE ELBOW-JOINT.

SURGICAL ANATOMY.

Fig. 1. The elbow joint is composed of the inferior extremity of the humerus, A, and the superior extremities of the radius, B, on the outside, and the ulna, C, on the inside.

Fig. 2. The radius is merely in juxtaposition with the humerus, whilst the ulna receives its trochlea in a corresponding depression of considerable depth, formed by the olecranon, *b*, behind, and the coronoid process, *c*, in front; this arrangement prevents the articulation from being opened directly, except from its outer side. The articular surfaces are retained in contact by anterior, posterior, and lateral ligaments.

Fig. 3. To recognize the exact position of the articulation, its relation to the neighboring bony projections is to be determined; the internal condyle, or epitrochlea, *b*, is prominent and easily detected; the external condyle, or epicondyle, *a*, is less prominent, and blends insensibly with the external aspect of the humerus. The two condyles, situated almost exactly on a horizontal line to which the axis of the humerus is perpendicular, lie just above the inter-articular line, *c, d, e*, whose two extremities are unequally distant from the horizontal line *a, b*. In fact, its external end, *c*, is but three and a half lines below the most inferior point of the external condyle, *a*, whilst its internal extremity is at least double that distance below the most inferior point of the internal condyle, *b*, (*Malgaigne*.)

OPERATIONS.

Fig. 4. *Flap operation*.—*a, b, c*, form of the anterior flap.

Fig. 5. *a, b, c*, anterior flap turned upwards; *d*, elbow joints opened; *e*, knife about to complete the division of the anterior ligament of the joint.

Fig. 6. *Circular operation. Velpeau's method*.—*a, b*, fold of integuments reflected.

Fig. 7. Wound which is left after the circular operation ; *a*, lower end of the humerus ; *b*, section of the humeral artery.

MODES OF OPERATING.

§ 1. *Method with a single flap.*—(Fig. 4 and 5.)—The forearm should be supinated as completely as possible, and held in a slightly flexed position. The surgeon, then, standing on the inner side of the limb, grasps the soft parts lying immediately in front of the articulation, and raises them from the bones of the forearm. He passes in a straight knife, from the inner side of the joint, about an inch below the prominence of the internal condyle, and keeping its point well in contact with the bones of the forearm, bring it out half an inch below the prominence of the external condyle, and cuts out a semi-circular anterior flap three inches in length. This flap being at once carried backwards by an assistant, who also retracts the skin of the arm so as to draw the angles of the wound as far upwards as possible, the surgeon carries his knife to the outside of the limb at the base of the flap, and at once enters its heel between the articulation of the radius with the humerus ; he then continues his transverse incision across the back part of the forearm through all the tissues, until he reaches the inner angle of the wound. Nothing remains then but to divide the anterior and lateral ligaments of the joint with the point of the knife, and, by luxating the bones forward, to cut through the insertion of the *triceps*, which is still attached to the olecranon process.*

§ 2. *Circular operation. Velpeau's method.*—(Fig. 6 and 7.)—The arm being held in the same position as in the preceding operation, but the surgeon standing on the outside of the limb, a circular incision is made around the forearm three fingers' breadth below the elbow joint ; the integuments are dissected up as far as the joint, and reflected upwards, and then the muscles in front of the joint are cut through, with the lateral ligaments, the joint entered in front, and the operation terminated by the division of the triceps behind.

In this mode of operating, the brachial artery is divided above its bifurcation, and the form of the wound is supposed to favor its union by the first intention.

* Some surgeons prefer to saw across the olecranon, and thus to leave the insertion of the triceps muscle untouched. The result is not materially different.—Eds.

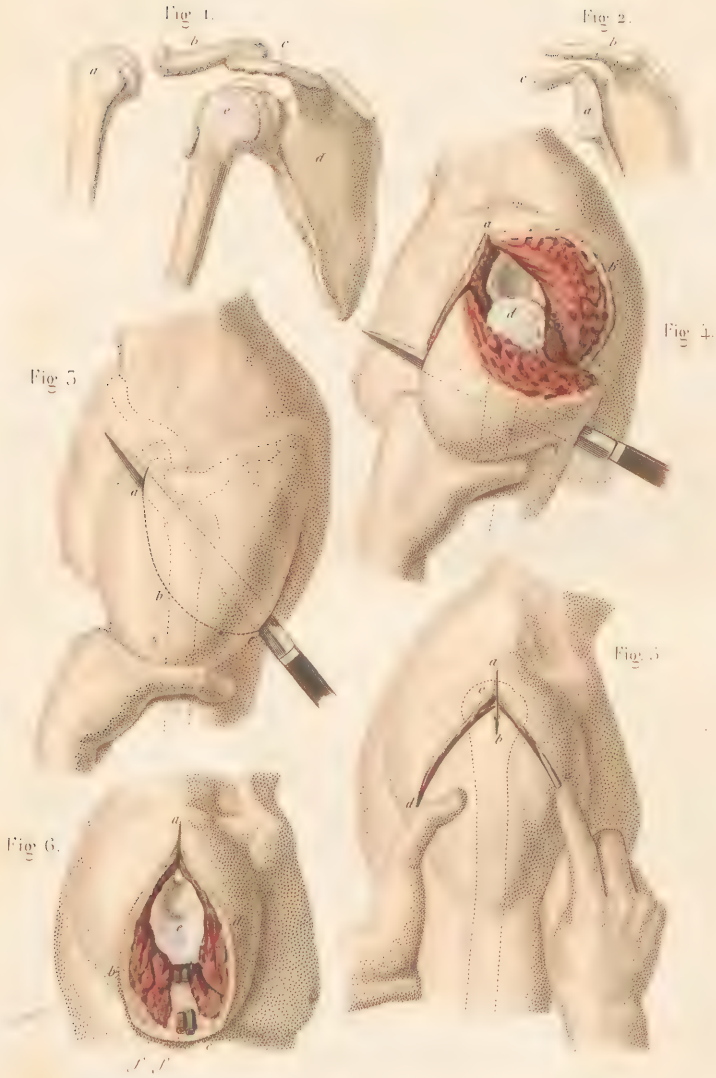


PLATE XXII.

AMPUTATION AT THE SHOULDER JOINT.

SURGICAL ANATOMY.

FIG. 1. *a*, head of the humerus ; its shape is that of an almost perfect hemisphere ; *b*, clavicle ; *c*, acromion ; *d*, infra-spinous fossa of the scapula ; *e*, head of the humerus, connected with the glenoid cavity by the capsular ligament of the joint.

FIG. 2. *a*, glenoid cavity ; it presents an elongated concave articular surface which receives but about one-third of the articular surface of the head of the humerus ; *b*, acromion ; *c*, coracoid process.

The head of the humerus is connected with the glenoid cavity by a loose capsular ligament, which would allow a considerable amount of separation between the articular surfaces, if they were not also retained in contact by the muscles arising from the scapula. The *supra-spinatus*, the *infra-spinatus*, the *teres major* and *minor* behind, and the *subscapularis* in front contribute to strengthen the joint, as well as the ligamentous fibres extending from the acromion to the capsule of the joint, and the *deltoid muscle*.

The acromion and coracoid processes form an arch which protects the articulation above. The acromion is situated nearly half an inch above the glenoid cavity, and projects an inch beyond it. The coracoid process situated within and lower down, is more nearly in contact with the head of the humerus.

OPERATIONS.

FIG. 3. *Lisfranc's operation*.—*a, b, c*, shape to be given to the posterior flap.

FIG. 4. *a, b, c*, posterior flap raised upwards ; *d*, head of the humerus disarticulated.

FIG. 5. *Larrey's operation*.—*ab*, first incision, vertical ; *cd*, posterior incision taking its origin from the first ; *ce*, anterior incision starting also from the same point.

FIG. 6. *a, b, c, d*, wound which is left after the preceding operation ; *e*, glenoid cavity and remains of the capsular ligament ; *f*, axillary vessels.

MODES OF OPERATING.

§ 1. *Disarticulation of the shoulder.—Operation with two flaps.—Lisfranc's method* (fig. 3, 4).

1st. The patient is supported in a convenient position upon a chair, and the arm kept close to the trunk, the head of the humerus at the same time being pushed upwards and outwards as much as possible. The surgeon then, being provided with a long straight knife cutting on both edges, assures himself of the exact position of the acromion and coracoid processes. If it is the left shoulder upon which he is about to operate, the point of the knife should be entered in a direction almost parallel with the humerus at the outer side of the posterior border of the axilla, in front of the tendons of the *latissimus dorsi* and *teres major* muscles. As the knife passes in, the plane of its blade should form an angle of 35° with the axis of the shoulder, and its point should graze the posterior and external surface of the humerus, until it reaches the under surface of the acromion ; at this point the handle of the knife should be raised, and its point lowered, so that it is brought out below and in front of the clavicle, in the triangular space between the acromion and coracoid processes, which is bounded posteriorly by the clavicle. The knife should then be made to cut its way outwards around the head of the humerus, and as soon as it becomes disengaged from beneath the acromion, the arm is carried a little distance away from the trunk, and the surgeon grasps with his left hand the deltoid muscle, raising it as much as possible from the bone, and carries the knife directly downwards, grazing the bone, and cutting out a posterior semicircular flap about three inches in length. In making this flap the upper part of the capsule of the joint should be divided, as well as the tendons of *latissimus dorsi*, the *teres major* and *minor*, and a part of the deltoid.

2d. The head of the humerus being readily separated from the glenoid cavity after the division of the parts just mentioned, the operator passes the blade of the knife behind it, and carries it downwards and forwards, grazing the humerus, to cut out the internal flap, and at this moment the artery contained in the substance of this flap should be compressed by an assistant. In operating upon the shoulder of the

right side the same rules are followed, except that the knife should be entered in the infra-clavicular triangle described above, to be brought out at the posterior border of the axilla, thus reversing the direction of the knife in transfixing the articulation to cut out the posterior flap.

§ 2. *Oval operation.*—*Larrey's method* (fig. 5, 6).—Make a vertical incision on the outer surface of the shoulder through the skin and subjacent tissues down to the bone, and extending from the edge of the acromion process to a point one inch below the top of the humerus; 2d, make then two oblique incisions starting from the centre of the vertical one, one on the anterior, and the other on the posterior aspect of the joint, carrying them through the tissues composing the anterior and posterior walls of the axilla, to the lower border of each, and dividing their attachments to the humerus; 3d, push the edges of the wound on either side to expose the joint, and open it, making traction on the bone to put its ligament on the stretch; 4th, luxate the bone, pass the knife behind it, and finish the operation by cutting directly through the tissues in the axilla, which intervene between the extremities of the incisions already made, recollecting that the artery is contained in them, and requires to be compressed by an assistant. The wound which results from this operation is almost perfectly oval in shape (fig. 6).

PLATE XXIII.

DISARTICULATION OF THE TOES.

SURGICAL ANATOMY.

Fig. 1. *Bones of the foot.—Dorsal aspect.*—*a* and *b*, inferior extremities of the tibia and fibula; *c*, astragalus; *d*, os calcis; *e*, scaphoid; *f*, cuboid; *g*, internal cuneiform; *h*, middle cuneiform; *i*, external cuneiform; 1, 2, 3, 4 and 5, first, second, third, fourth and fifth metatarsal bones; *k, k, k, k, k*, phalanges of the toes.

Fig. 2. *Articular ligaments of the dorsum of the foot.*—*a, a*, anterior tibio-tarsal ligaments; *b*, anterior fasciculus of the internal lateral ligament; *c*, internal calcaneo-scaphoid ligament; *d*, external calcaneo-astragaloid ligament; *e*, superior astragalo-scaphoid ligament; *f*, the superior calcaneo-cuboid ligament; *g, g, g*, scaphoido-cuneiform ligaments; *h*, cuboido-metatarsal ligament; *i, i, i*, cuneo-metatarsal ligaments; *k, k, k, k, k*, articulations of the metatarsal bones between themselves, and of the phalanges with the metatarsal bones; *l, l, l, l, l*, lateral ligaments of the phalanges.

Fig. 3. *Horizontal section of the bones of the tarsus*, showing the inter-articular ligaments.

OPERATIONS.

Fig. 4. *Disarticulation of the third, and of the great toe.*—*a, b, c, d*, wound resulting from the oval operation; *e*, head of the first metatarsal bone; *f, g, h*, wound resulting from the flap operation; *i*, head of the third metatarsal bone.

Fig. 5. *Disarticulation of the five toes together.*—*a, b, c*, form and direction of the incision across the heads of the metatarsal bones.

Fig. 6. The integuments *a, b, c*, are retracted, and the knife is carried behind the heads of the phalanges in order to make a flap from the plantar surface of the foot.

Fig. 7. Wound which results from the preceding operation.—*a, b, c*, shape of the plantar flap.

Fig. 1.



Fig. 5.



Fig. 4.



Fig. 2.



Fig. 6.



Fig. 5.



Fig. 9.

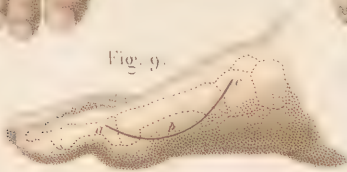


Fig. 7.

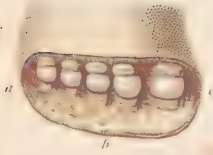


Fig. 8.

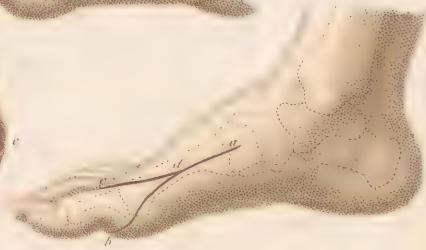


Fig. 8. *Disarticulation of the first metatarsal bone.*—*a, b, c, d*, outline of the incision.

Fig. 9. *a, b, c*, incision employed in disarticulation of the first metatarsal bone, without removing the great toe, (see “exsections.”)

MODES OF OPERATING.

§ 1. *Disarticulation of a single toe* (fig. 4.)—The rules laid down for the disarticulation of the fingers are entirely applicable to the corresponding operations upon the toes; we will only remark, that the oval operation is most generally preferable, as it is very rare that less than an entire toe is removed; the small size of the phalanges, and their unimportance, renders the preservation of a single phalanx a matter of much less moment than in the hand.

It has been proposed by many surgeons, that in disarticulation of the great toe, (fig. 8,) the head of its metatarsal bone should be removed at the same time, on account of the unsightly projection, which, moreover, is a source of constant irritation from the friction of the shoe in walking. (See “exsection” for further remarks on this subject, and for amputation of the metatarsal bones.)

§ 2. *Disarticulation of all the toes at the same time. Flap operation. Lisfranc's method* (fig. 6 and 7.)—1st. The operator, grasping all the toes in his left hand, makes, with a narrow knife, a semi-circular incision, extending (for the left foot, and *vice versâ*) from the internal border of the first metatarsal bone, to the external border of the fifth, in front of the articulations of the toes with the metatarsus, (fig. 5); 2d, the articulations are opened in succession with the point of the knife, and their ligaments divided; 3d, the knife is then carried behind the phalanges for the purpose of cutting out a semi-circular flap from the plantar surface of the foot, (see fig. 6.)

PLATE XXIV.

AMPUTATION THROUGH THE TARSO-METATARSAL ARTICULATION.

SURGICAL ANATOMY.

Fig. 1. The tarso-metatarsal articulation, formed posteriorly by the cuboid, *a*, and the three cuneiform bones, *b*, *c*, *d*, and in front of the five metatarsal bones, presents an irregularly curved line, the general direction of which, with its irregularities, require attention. Externally, the cuboid, *a*, articulates with the fourth and fifth metatarsal bones, making a line somewhat oblique from without inwards, and from behind forwards. This line presents a very obtuse angle about its middle, the articulation of the fourth being less oblique than that of the fifth metatarsal bone. About the twelfth of an inch farther forwards is the articulation of the third metatarsal with the internal cuneiform, *b*; at least two lines behind this articulation lies that of the second metatarsal with the middle cuneiform, *c*; and, finally, nearly the third of an inch in front of the last we find the line of articulation of the first metatarsal with the internal cuneiform, *d*.

This arrangement presents two especial points for the consideration of the operator: 1st, the internal extremity of the articulation lies at least seven lines anterior to a transverse line *e, f*, drawn directly through its external extremity; 2d, the proximal extremity of the second metatarsal bone is enclosed in a mortise formed by the three cuneiform bones, *b, c, d*, which is at least one-third of an inch deep antero-posteriorly.

The dorsal ligaments connecting the tarsal and metatarsal bones are inserted several lines behind and in front of the inter-articular line, and hence the articular surfaces can always be partially separated, even when these are cut across not exactly upon the inter-articular line. The interosseous ligaments, which are stronger towards the plantar aspect of the foot, are generally easily divided; nevertheless, those situated on the inner side of the mortise, which connect the second metatarsal with the first and second cuneiform bones, the real key to the articula-

Fig 1st



Fig 1



Fig 2



Fig 5



Fig 4



Fig 5



tion, require for their ready division a particular manœuvre to be hereafter described.

To recognize the articulation.—1st. On the inner side of the foot, carry the finger backwards along the inner border of the first metatarsal bone until a projection is encountered, *g*; one or two lines beyond this is the articulation, situated in a depression between the two projections marked *g* and *h*, the internal cuneiform. The articulation may also be found just one inch anterior to the prominence of the scaphoid bone, *i*.

2d. On the outer side: Follow the external border of the fifth metatarsal bone until the prominence at its proximal extremity is recognized, *k*; the articulation lies immediately behind it; in some instances, the head of the metatarsal bone projects a trifle beyond the articulation.

OPERATIONS.

Fig. 1 bis. *Lisfranc's method.*—*a, b, c*, form and direction of the incision to be made across the metatarsus.

Fig. 2. *a, b, c*, dorsal ligaments of the tarsus, divided.

Fig. 3. *Manner of opening the mortise formed by the head of the second metatarsal bone.*—*a, b, c*, are of the circle to be described by the knife; *d*, second metatarsal; *e*, first metatarsal bone.

Fig. 4. *a*, *dorsalis pedis* artery. The knife, *b*, is in the act of cutting out the plantar flap.

Fig. 5. *a, b, c, d*, wound left after the operation; *a, b, c*, shape of the plantar flap.

MODES OF OPERATING.

1st. The patient is placed upon his back, and the foot rotated moderately inwards. The surgeon recognizes the exact situation of the articulation by the rules already laid down, and then grasps, with the palm of his left hand, the sole of the foot, his thumb being placed on the outer side of the proximal end of the fifth metatarsal bone, and the index finger at the internal extremity of the articulation. He then makes a semi-lunar incision with its convexity looking downwards, from without inwards, across the dorsum of the foot, passing about half an inch below the articulation, and extending from one of its extremities to the other down to the bones.

2d. The surgeon divides, with the point of his knife, the dorsal ligaments, carrying it along the line of the articulation from without in-

wards, as already indicated, and recollecting that the articulation of the second metatarsal lies a third of an inch posterior to the others, (fig. 2.)

3d. The mortise in which the head of the second metatarsal is enclosed remains to be opened. This is effected by introducing the point of the knife between the internal cuneiform and the head of the first metatarsal bone, its edge being turned upwards, and making an angle of 45° with the axis of the foot. The knife is then carried up to a right angle, its point traversing the whole of the inner surface of the mortise, in order to insure the division of the interosseous ligament; it is then withdrawn, and applied to the external surface of the mortise.

4th. When this has been accomplished, pressure is made upon the metatarsus to separate the articular surfaces, and their remaining ligamentous attachments are successively divided, especially those on the plantar aspect of the articulation, so that the knife may be carried readily beneath the heads of the metatarsal bones, and the operation is then finished by cutting out a flap from the sole of the foot, which should be somewhat larger at its internal than at its external part.*

*The operation above described is generally known in this country as *Lisfranc's operation* on the foot, and it is distinguished by this title from *Hey's operation* through the metatarsus, in which the bones are divided with the saw, and *Chopard's operation* through the tarsus, as next described.—EDS.

Fig. 1.

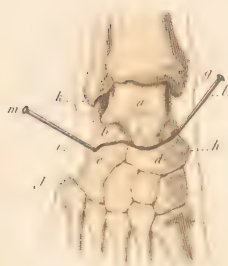


Fig. 2.

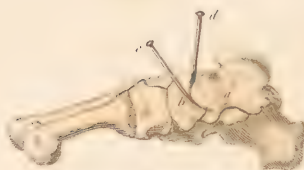


Fig. 3.



Fig. 4.



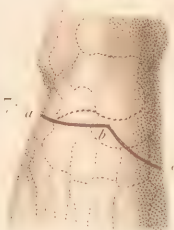
Fig. 5.



Fig. 6.



Fig. 7.



AMPUTATION THROUGH THE TARSUS, OR CHOPART'S OPERATION.

SURGICAL ANATOMY.

FIG. 1. The articulation at the middle of the tarsus is formed by the astragalus, *a*, and the os calcis, *b*, behind, and by the cuboid, *c*, and scaphoid, *d*, in front, and the inter-articular line, which crosses the foot transversely, resembles the illic ∞ , of which the anterior convexity is internal, and its posterior convexity, external.

The internal extremity of the articulation is just one inch in front of the internal malleolus, *g*, and two lines and a half behind the tuberosity, *h*, of the scaphoid.

The external extremity, *i*, is half an inch behind the projection formed by the head of the fifth metatarsal bone, *j*. It corresponds with a prominence on the external surface of the cuboid bone, which is situated just one inch in front of the external malleolus, *k*.

The centre of the articulation lies immediately in front of the head of the astragalus, which can be made to project by forcibly extending the foot. On the outside of this prominence is a depression, sensible to the touch, lying between the astragalus, the cuboid, and the os calcis; the articulation is immediately in front of this (*Malgaigne*).

In order to cut through the joint readily, it is necessary to be familiar with the different directions which are assumed by its articular surfaces. The pin, *l*, introduced between the astragalus and scaphoid, indicates the direction to be given to the knife in opening the articulation from its internal side.

The pin, *m*, introduced between the os calcis and cuboid, just in front of the prominence on the cuboid mentioned above, indicates also the direction to be given to the knife in entering the joint from its external side.

FIG. 2. When it has once entered the articulation by its inner side, the blade of the knife should follow the different degrees of obliquity assumed by the articular surfaces, of the astragalus, *a*, and the os calcis, *b*; at first directed obliquely backwards as at *c*, it becomes almost perpendicular at *d*.

FIG. 3. In operating upon the right foot, the blade, slightly oblique at *c*, will become more nearly perpendicular at *d*, between the os calcis, *a*, and the cuboid, *b*, when the joint is entered from its external side.

The interosseous ligament which is found about in the centre of the articulation, and which connects the four bones together, should always be cut through with the point of the knife as soon as the bones can be sufficiently separated. In aged subjects it is sometimes ossified; in this case it must be divided with the saw. The other ligaments require no particular remark.

OPERATIONS.

FIG. 4. *Ordinary method*.—*a, b, c*, form and direction of the incision to be made across the joint.

FIG. 5. The joint being cut through, the knife is about making the flap from the sole; *a*, *dorsalis pedis* artery.

FIG. 6. *a, b, c*, form of the plantar flap; *d* and *d'*, the dorsal and plantar arteries.

FIG. 7. *Sedillo's method*.—*a, b, c*, form of the incision on the dorsum of the foot.

MODES OF OPERATING.

§ 1. *Chopart's operation through the middle of the tarsus* (fig. 4 and 5).—*Ordinary method*.—1st, the exact position of the articulation having been recognized by the means already indicated, the surgeon grasps the foot with his left hand, its sole being placed in his palm, his thumb upon the external extremity of the articulation, and the index finger upon the tuberosity of the scaphoid bone; 2d, the knife is then to be carried across the dorsum of the foot, from the thumb towards the index finger (fig. 4), making a semi-circular incision which descends about half an inch below the line of the articulation; 3d, after the retraction of the integuments, divide the tendons which remain uncut, and open the articulation, bearing in mind the varying obliquity of the articular surfaces as already indicated, and also to divide thoroughly the fibrous bands connecting the scaphoid and astragalus before attempting to enter the joint, as the thin edge of the scaphoid juts over the latter in some degree; 4th, the articulation being entirely laid open, and all its ligaments freely divided, pass the flat of the blade behind the bones, and having brought up the end of the foot into its natural position, cut out a flap from its plantar surface, which should extend be-

yond the sesamoid bones in order to possess sufficient length; the knife should graze the bones in making the flap, care being taken to avoid the projections of the scaphoid, cuboid and first and fifth metatarsals.

§ 2. *Sedillot's method* (fig. 6 and 7).—After determining the position of the articulation, and the foot being properly supported, a transverse incision is made, commencing a few lines in advance of the calcaneo-cuboid articulation, and terminating about the middle of the dorsum of the foot, on the outer side of the tendon of the *tibialis anticus*. From this same point a curved incision, with its convexity downwards, is then carried around the inner border of the foot, extending downwards to within two fingers' breadths of the metatarso-phalangeal articulation of the great toe, and thence across the sole to the commencement of the first incision. The plantar integuments should be cut as much as possible in a slanting direction to rid their edges of the subcutaneous fat, the protrusion of which tends to prevent the union by the first intention. It remains now to dissect up the internal flap to just beyond the tuberosity of the scaphoid bone, where the joint is to be entered. The disarticulation is then completed as usual, and the remaining soft parts divided transversely.*

* *Amputation through the ankle-joint*, although not an operation in general use at the present day, is highly praised by Baudens, amongst the French surgeons, and also by Mr. Syme of Edinburgh, who has lately reintroduced it with much success. Each of these surgeons has a mode of operating peculiar to himself. (See Malgaigne, Eng. ed., p. 255, and Lond. and Ed. Monthly Journal, Feb., 1843, p. 93.)—EDS.

PLATE XXVI.

AMPUTATION AT THE KNEE-JOINT.

SURGICAL ANATOMY.

Fig. 1.—*Anterior view of the knee-joint.*—*a*, femur; *b*, patella; *c*, tibia; *e*, fibula; *g*, external lateral ligament; *f*, internal lateral ligament; *d*, ligament of the patella.

Fig. 2. *A vertical antero-posterior section exhibiting the crucial ligaments, d, and the popliteal artery, e.* *a*, femur; *b*, tibia; *c*, patella.

This articulation possesses some anatomical peculiarities worthy of the attention of the operator. The internal condyle descends lower than the external, nearly half an inch. They are both received into concave articular surfaces on the head of the tibia, which are rendered deeper by the semi-lunar cartilages attached to their edges. The popliteal artery, (fig. 2, *e*) lies in the depression between the two condyles, posteriorly, and in immediate contact with the joint.

In addition to the patella and its tendinous connections, the articular surfaces are held together by an internal and external lateral ligament, a posterior ligament, and two very strong interosseous ligaments, called crucial, which also tend to prevent displacement in an antero-posterior direction.

To determine the exact position of the joint, find out the head of the fibula, and three-fourths of an inch above it is the inner side of the articulation. On the external aspect of each of the condyles of the femur is a prominence of bone which can generally be felt beneath the integuments; the articulation lies three-fourths of an inch below these. The lower border of the patella, also, is exactly on a line with the joint.

Fig. 5.



Fig. 1.



Fig. 5.



Fig. 2.



Fig. 4.



Fig. 6.





OPERATIONS.

FIG. 3. *Amputation through the knee-joint.—Flap operation.*—*a, b, c*, form to be given to the anterior incision.

FIG. 4. Same operation.—The articulation having been opened, the knife is cutting out the posterior flap; *a, b, c*, shape to be given to this flap.

FIG. 5. *Same operation by the circular method.*—*a, b, c*, section of the skin; *d, e*, integuments reflected; the knife is just entering the joint in front.

FIG. 6. *Same operation by the oval method.—Bauden's process.* *a, b, c*, oblique section of the skin; *d, e*, integuments turned upwards; the knife is opening the articulation from before backwards.

MODES OF OPERATING.

§ 1. *Amputation through the knee-joint.—1st. Flap operation.—Hoin's method.*—1st, the limb being extended make a semi-circular incision across the front of the articulation immediately below the patella, and extending from one condyle of the femur to the other; 2d, by a second incision, in the same direction, bending the knee slightly, open the joint freely, and dividing all its ligamentous connections, pass the knife flatwise behind the head of the tibia, and cut out a flap from the calf of sufficient size to cover well the condyles of the femur.

§ 2. *Circular operation.—Velpeau's method.*—1st, make a circular incision around the limb, from three to four fingers' breadths below the patella, through the integuments only; 2d, dissect them up and reflect them backwards, preserving as much of the subcutaneous fat with the skin, as possible; 3d, the reflected integuments being held back by an assistant, and the knee flexed, carry the knife through the articulation, dividing all its ligamentous attachments, and cut through the nerves, vessels and muscles behind the joint at one stroke, perpendicular to the axis of the limb, and on a line with the reflected integuments.

§ 3. *Oval operation.—Bauden's method.*—1st, draw with a pen and ink an oblique line starting from the crest of the tibia three fingers' breadths below the patella and running backwards and upwards to the popliteal space, and terminating two fingers' breadths below the line of the articulation, and thence down the opposite side of the limb to the

point from which it started ; 2d, follow this line with the knife, dividing the integuments only, which should be dissected up as far as the line of the articulation and reflected upwards. The disarticulation is then effected as in the circular operation, the joint being opened from the front.

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Case for Microscopic Anatomy, from	4.50 to 12.00
Mercury Syringes,	10.50
Robin's small Syringe,	7.50